

ROYAL COMMISSION ON TUBERCULOSIS (HUMAN AND BOVINE).

FINAL REPORT OF THE ROYAL COMMISSION
APPOINTED TO INQUIRE INTO THE RELATIONS OF
HUMAN AND ANIMAL TUBERCULOSIS.

PART II. APPENDIX.

VOLUME III.

REPORTS ON INVESTIGATIONS

DEALING WITH

- 1.—Certain Human Viruses of Irregular Type.
- 2.—The Excretion of Tubercle Bacilli in the Milk of Animals.
- 3.—Swine Tuberculosis.
- 4.—Immunity.

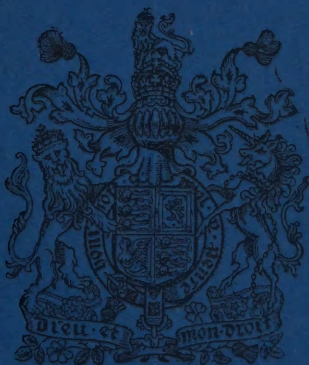
BY

A. STANLEY GRIFFITH, M.D., and F. GRIFFITH, M.B.,

TOGETHER WITH

Two Reports submitted to the Commission in 1906 by Dr. L. COBBETT.

Presented to both Houses of Parliament by Command of His Majesty.



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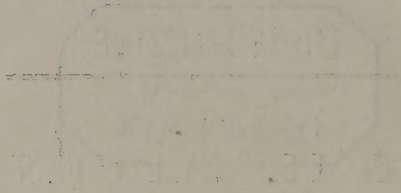
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FINAL REPORT OF THE ROYAL COMMISSION

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REPORTED BY THE ROYAL COMMISSION

HUMAN AND ANIMAL TUBERCULOSIS



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ROYAL COMMISSION

REPORTS ON INVESTIGATIONS

1. Certain human varieties of tubercular virus

2. The existence of tubercular virus in the milk of animals

3. Avian tuberculosis

4. Immunity

A STANLEY CRISTIE, M.D., FOR A CRISTIE, M.D.

The Report submitted to the Commission in 1900 by Dr. J. CRISTIE

Printed by the Government Printer, London, in 1900, at the Stationers' Hall, 6, Abchurch Lane.

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PREFACE.

This volume contains the Reports of four separate investigations carried out at Stansted under the direction of the Commission, the first two being the work of Dr. A. Stanley Griffith alone and the others of himself and Dr. F. Griffith jointly.

The first Report, dealing with Human Viruses of Irregular Type, is divided into three parts, two of which refer to further investigations of certain viruses that had already been investigated by Dr. Cobbett and placed provisionally by the Commission in a group by themselves. The details of the previous investigation of these viruses will be found in the Commission's Second Interim Report and Appendix. The third part deals with the cultures isolated since the issue of the Second Interim Report from two human viruses that exhibited similar features to those other irregular ones placed in Group III.

The second Report in this volume gives the details of an investigation in connection with the excretion of tubercle bacilli in the milk of animals (goats and cows) after experimental inoculation. The results of Dr. F. Griffith's investigations into the excretion of tubercle bacilli in the milk of similar animals naturally infected with tuberculosis, but showing no evidence of disease of the udder, have already been published in the Commission's Third Interim Report and Appendix issued in 1909.

The investigation of Swine Tuberculosis, which forms the subject of the third Report contained in this volume, was carried out at Walpole Farm. The experiments were commenced by Dr. A. Stanley Griffith and, after he was transferred to Blythwood Farm, continued by Dr. F. Griffith.

The whole of the experimental work on which the last Report, namely that on Immunity, is based was carried out by Dr. A. Stanley Griffith and Dr. F. Griffith jointly at Walpole Farm.

Two Reports submitted to the Commission in 1906 by Dr. Cobbett on certain investigations carried out by him at Blythwood Farm are also included in this volume. These Reports deal with the Stability of Virulence of Tubercle Bacilli in the Living Body and Experiments with Mixed Viruses. They are referred to in the Second Interim Report of the Commission (pages 41 and 42), but as the experiments were of a preliminary nature the Reports on them were not included in the Appendix to that Report. The two Reports have not been revised by Dr. Cobbett to include subsequent experiments on the same subjects carried out at Blythwood, but are now printed as originally written by him.

EDWARD J. STEEGMANN.

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BY

A. STANLEY GRIFFITH, M.D.

INVESTIGATION OF CERTAIN HUMAN VIRUSES OF IRREGULAR TYPE.

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INTRODUCTION.

In the 2nd interim report the results are given of experiments with certain viruses, which, on account of their exceptional features, were put together in a separate group (Group III.).

The cases differed widely, and included—

(1) A virus of a character intermediate between Group I. and Group II. (H 49. "T.C.").

(2) Viruses in which a eugonic bacillus of low virulence had been replaced by a dysgonic bacillus of high virulence ("Passage" experiments H 16. "J.H.", H 13. "A.D.", H 17. "Sp.B.").

Two possible explanations of the cases were put forward and discussed by the Commission.

The first was that the results obtained were due to a mixture of viruses, of a virus from a human source and a virus from a bovine source, each possessing stable characters.

The second was that tubercle bacilli under conditions as yet not definable may manifest instability, and may, when subjected to vital influences, such as are supplied by human or bovine tissues, become modified in character.

A definite decision as to which of the two views is the true one was held over pending further work with the cultures obtained at various stages of the experiments. All the work in connection with these original experiments, which are detailed in the Second Interim Report and summarised in this, was done by Dr. Cobbett.

The further investigation of the cultures was entrusted to me, Dr. Cobbett being unable to complete the work on account of his appointment to the Chair of Pathology in the University of Sheffield, and I was directed by the Commission first to test the cultural characters and the virulence of the cultures that existed of the various viruses which had been included in this group (Group III), and then to investigate specially those cultures which exhibited any want of accordance between cultural characters and virulence.

In order to save the necessity of referring to previous reports for the origin of the cultures, a brief summary, illustrated by marginal diagrams, is given of all the viruses reinvestigated.

These viruses are H 13. "A.D.", H 16. "J.H.", H 17. "Sp.B.", and H 49. "T.C.".

Cultures from the virus H 2. "Sp.A.", the original material of which was mixed sputum, were also investigated.

The further investigations with the lupus virus H 53. "D.H.," which had been provisionally included in Group III, are recorded in Volume II of the Appendix.

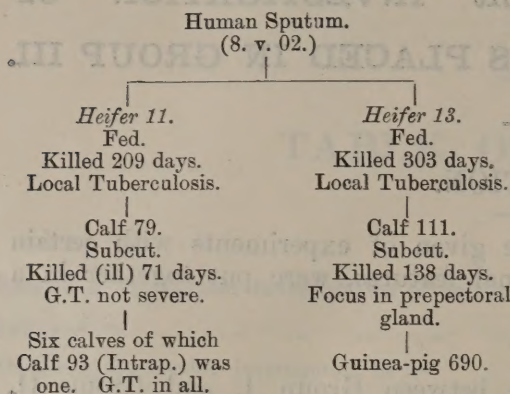
VIRUS H 2. "Sp. A."

(Mixed Sputum.)

RECAPITULATION.

Two heifers, Nos. 11 and 13, were fed every day with sputum from persons suffering from pulmonary tuberculosis, one for about 200, the other for about 300 days. Heifer 11 was killed 209 days after the

experiment began ; several mesenteric glands and a few hepatic lymphatic glands were found to be tuber-



culous, caseous and calcareous, and there was a pedunculated growth on the lung. An emulsion from the mesenteric glands, injected subcutaneously into a calf, gave rise to general though not fatal tuberculosis.

Emulsions from various lymphatic glands of this second animal injected into six calves, two subcutaneously, two intraperitoneally, and two intravenously, gave rise to general progressive tuberculosis fatal in the two inoculated intravenously but not in the others within 90 days.

In the other heifer, No. 13, calcareous mesenteric glands were found after death. An emulsion from these calcareous glands, injected subcutaneously into Calf 111 gave rise to a small nodule in a prepectoral gland only, while the same emulsion passed through a guinea-pig produced in one calf fatal generalised tuberculosis, and in another slight retrogressive tuberculosis.

A culture isolated from the prescapular gland of Calf 111 through Guinea-pig 690 was found by Dr.

Cobbett to be eugonic and to have low virulence for the calf and rabbit ; it produced in broth a well-marked acid reaction (A.S.G.). A culture from Calf 93, one of the six calves inoculated with the virus from Heifer 11, grew less well than the culture from Calf 111 and was fully virulent.

RESULTS OF REINVESTIGATION.

Two strains of the virus existed, the one derived from Calf 93, the other from Calf 111.

Virulence Tests.—The culture from Calf 93 was retested after three years eight months' artificial cultivation. A series of five rabbits was inoculated, two intravenously, two intraperitoneally, and one subcutaneously. The subcutaneous rabbit died of heart disease in five days ; the others died of general tuberculosis in from 18 to 33 days. The culture derived from Calf 111 was tested after three years three months' artificial cultivation. A series of seven rabbits was inoculated, two intravenously, two intraperitoneally, and three subcutaneously. All were killed after 111 days and showed slight retrogressive tuberculosis only.

Cultural Characters.—The culture from Calf 93 grew moderately well on glycerin media but not better than the more easy growing cultures of bovine origin. The culture from Calf 111 grew luxuriantly like the human tubercle bacillus.

Summary.—The Calf 93 strain exhibited the characters of a bovine tubercle bacillus ; the Calf 111 strain those of a human tubercle bacillus.

VIRUS H 13. "A.D."

RECAPITULATION.

Tuberculous material obtained from the bronchial glands and spleen of a child, aged 4 years, who died of acute generalised tuberculosis, was mixed and inoculated subcutaneously into two calves and gave rise in each to a very limited retrogressive tuberculosis confined to the seat of inoculation and nearest glands.

Bronchial Glands
and Spleen.

Calf 129.
Subcut.

Killed 66 days.
Local Tuberculosis.

3 series of guinea-
pigs.

Calf 301.
Subcut.

Killed (very ill) 33 days.
General Tuberculosis.

Two calves of
which Calf 321 (Subcut.)
was one : G.T.

Rat 15.
K. 167 days.
G.T.

The virus from the prescapular gland of one of the calves was passed through three consecutive series of guinea-pigs and then inoculated into two calves, one subcutaneously, the other intraperitoneally.

The animal inoculated intraperitoneally was killed in 87 days and showed tuberculous peritonitis and tuberculosis of the thoracic and a few other glands and no disease of the organs. The other calf, No. 301, inoculated subcutaneously, was killed when very ill after 33 days, and showed severe general tuberculosis.

An emulsion made from the thoracic glands of Calf 301 gave rise in two calves (of which one was Calf 321), after subcutaneous inoculation, to severe general progressive tuberculosis, and to fatal tuberculosis in two rabbits. Cultures were isolated from the mediastinal gland of Calf 301, the prescapular gland of Calf 321, and from a rat, No. 15, which had been inoculated with the emulsion from Calf 301.

The culture from Calf 301 was eugonic and had irregular virulence ; inoculated, after fifteen months' artificial cultivation, into two calves, in a dose of 50 milligrammes, it produced in one slight general

tuberculosis, the lesions in the lungs resembling those produced by a Group I bacillus, and in the other tuberculosis limited to the site of inoculation and the nearest gland ; in rabbits slight disease was produced in one animal and chronic general tuberculosis in two others.

The cultures from Calf 321 and Rat 15 were dysgonic and fully virulent.

RESULTS OF REINVESTIGATION.

The cultures from Calf 301 and Rat 15 were the only two which had been preserved.

The last subculture (24th generation) of the strain from Calf 301 was about three months old and

subcultures from it on to serum failed; in order to recover it a guinea-pig was inoculated and several tubes of the egg medium were sown at the same time; the guinea-pig died of tuberculosis, but since growth had taken place on the egg tubes it was unnecessary to isolate a culture from this animal. The strain now grew readily on serum, and after three subcultures on this medium, its virulence was tested.

Virulence Tests.—The strain from Calf 301 was inoculated into a series of six rabbits, two intravenously, two intraperitoneally, and two subcutaneously; the culture used was the 28th generation, the strain having been three years in artificial cultivation. One rabbit died after two days of causes other than tuberculosis. The remaining five died of general tuberculosis in from 12 to 52 days, the duration of life being a little longer than in rabbits inoculated with equivalent doses of bovine tubercle bacilli. Two cats inoculated at the same time as the rabbits died of acute tuberculosis.

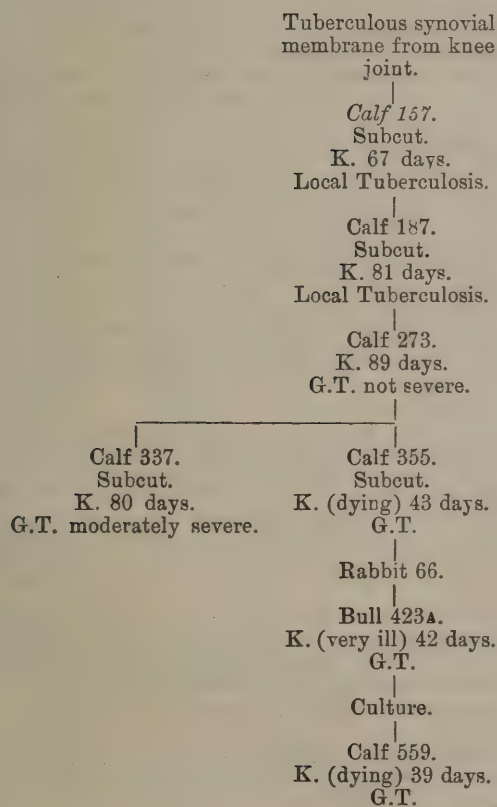
The culture derived from Rat 15 was inoculated into a series of four rabbits (two intravenously and two intraperitoneally). The culture used was the 25th generation and the strain had been two years 7½ months in artificial cultivation. The rabbits inoculated intravenously (doses 1.0 and 0.1 mg.) died of general tuberculosis in 13 and 25 days, the intraperitoneal rabbits in 101 and 106 days; the prolonged duration of life in the latter two was due to the injection being in one partly intracoecal and in the other partly subcutaneous and partly intracoecal.

Cultural Characters.—The culture from Calf 301 grew well on the differential media, the growths obtained closely resembling those produced by the human tubercle bacillus (Group II.). The strain from Rat 15 was dysgonic.

Summary.—The Calf 301 strain exhibited the cultural characters of a human tubercle bacillus, but resembled the bovine tubercle bacillus in its virulence. The Rat 15 strain was identical with a bovine tubercle bacillus.

VIRUS H 16. "J.H."

RECAPITULATION.



The original material in this case was the tuberculous synovial membrane removed from the knee joint of an adult man; the membrane was emulsified and inoculated subcutaneously into two calves. The calves were killed 54 and 67 days after respectively, and showed in each case a small local lesion and slight disease of the nearest gland, and in one case a calcareous focus in a bronchial gland.

An emulsion of the prescapular gland of one of the calves, No. 157, inoculated subcutaneously into another calf, No. 187, produced a small calcareous local lesion only.

An emulsion of this local lesion and the adjacent gland was made and inoculated subcutaneously into Calf 273; this calf was killed in 89 days and showed a local lesion, enlargement and caseation of the prescapular gland, many tuberculous nodules in the lungs, some tuberculosis of the liver and spleen, thoracic and hepatic glands, and one parotid lymphatic gland.

The prescapular gland of Calf 273 was emulsified and inoculated into two calves subcutaneously (Nos. 337 and 355) and one rabbit intraperitoneally. The rabbit died of general tuberculosis in 43 days, the other was killed in 80 days and showed general progressive tuberculosis. With an emulsion made from the prescapular gland of Calf 355, four calves and two rabbits were inoculated. The two rabbits died of general tuberculosis and all the calves developed general progressive tuberculosis.

The virus from one of these rabbits (Rabbit 66) was inoculated into a bull (Bull 423A), which was killed when very ill 42 days later and showed general tuberculosis. The culture isolated from this bull was fully virulent.

Cultures isolated from Calf 157, from a guinea-pig inoculated with the original material, and from the

prescapular gland of Calf 273 were eugonic and had low virulence for the calf and rabbit; cultures from Calf 337 and Bull 423A and Calf 559 were dysgonic and virulent.

RESULTS OF REINVESTIGATION.

Three strains of the virus were alive, those from Calf 273, Bull 423A, and Calf 559.

Virulence Tests.—The culture derived from the prescapular gland of Calf 273 was retested after 2 years 11½ months' artificial cultivation; the 36th generation of culture was used.

Six rabbits were inoculated, two intravenously, two intraperitoneally and two subcutaneously. All were killed when well 94 days later and showed slight tuberculosis of a chronic type.

The culture derived from the prepectoral gland of Bull 423A was tested on a series of five rabbits, two intravenously, two intraperitoneally, and one subcutaneously, after 2 years 6 months' artificial cultivation; the 29th generation of culture was used. The two intravenous and the two intraperitoneal animals died of general tuberculosis in from 17 to 26 days; the subcutaneous animal died of severe general tuberculosis in 126 days.

The culture derived from the hepatic gland of Calf 559 was tested after 2 years 1½ months' artificial cultivation; the culture used was the 25th generation.

Five rabbits were inoculated, two intravenously, two intraperitoneally, and one subcutaneously. All the rabbits died of general tuberculosis.

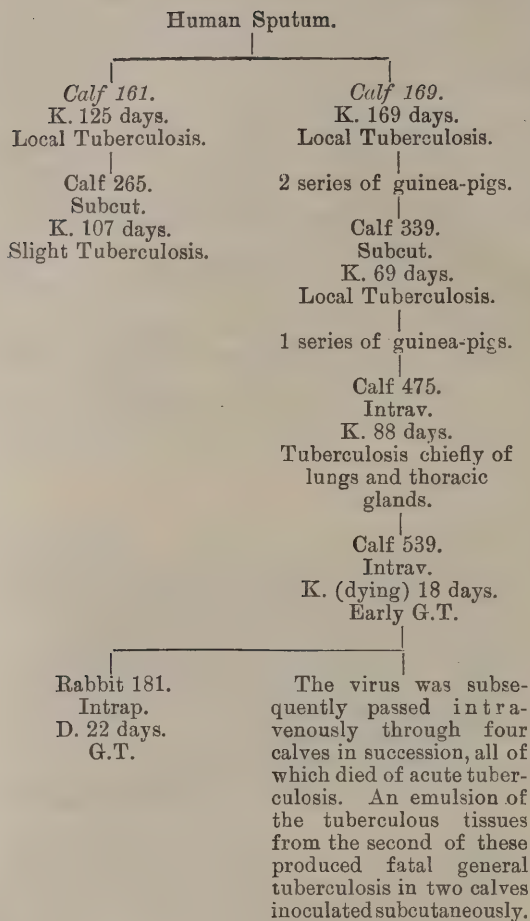
Cultural Characters.—The culture from Calf 273 was eugonic; the cultures from Bull 423A and Calf 559 were dysgonic.

Summary.—The Calf 273 strain was identical with the human tubercle bacillus, the other two strains with the bovine tubercle bacillus.

VIRUS H 17. "Sp. B."

(Mixed Sputum.)

RECAPITULATION.



Four calves were fed, one for 91, the others for 120 days with the mixed sputum from many patients suffering from pulmonary tuberculosis; in each animal a retrogressive calcareous tuberculosis was found limited practically to the glands of the alimentary tract.

The tuberculous mesenteric glands of one of the calves, No. 161, were emulsified and inoculated into two calves subcutaneously; one of the calves killed after 114 days showed no sign of tuberculosis, the other (Calf 265) had slight retrogressive tuberculosis. A culture isolated from the latter calf, injected subcutaneously into two calves in 50 mg. doses, produced only slight tuberculosis. This passage did not proceed any further.

The virus from two of the other original calves was also passed each through a series of animals, one through calves, the other through guinea-pigs, a calf, and goats, without any change in virulence.

The tuberculous mesenteric glands from the fourth calf (Calf 169) were emulsified and inoculated into a series of guinea-pigs, and from this series the virus was passed through another series of guinea-pigs and then inoculated into a calf (Calf 339); this calf showed a local lesion and tuberculosis of the nearest glands only.

The virus after passage through another series of guinea-pigs was inoculated intravenously into Calf 475. This calf was killed in 88 days and showed progressing tuberculosis confined chiefly to the lungs and thoracic lymphatic glands. An emulsion of the lung was inoculated intravenously into Calf 539 which was killed when dying of general tuberculosis in 18 days. The virus from this calf was inoculated intraperitoneally into Rabbit 181 (which died in 22 days of general tuberculosis), and was passed through a series of four calves in succession.

Cultures isolated from Calves 265 and 339 were eugonic and slightly virulent. A culture from Rabbit 181 was eugonic and at first virulent; when it had been in cultivation 16 months it was found to be only slightly virulent. The cultures isolated from calves which died of general tuberculosis were dysgonic and virulent.

RESULTS OF REINVESTIGATION.

Only two strains of this virus were alive, the one derived from Calf 265, the other from Rabbit 181.

Virulence Tests.—The strain from Calf 265 was retested after it had been three years in artificial cultivation. Six rabbits were inoculated, two intravenously, two intraperitoneally, and two subcutaneously. All were killed after 97 days and showed slight chronic tuberculosis of the usual type.

The strain derived from Calf 539 through Rabbit 181 was tested when two years and two months old (27th generation). Six rabbits were inoculated, two intravenously, two intraperitoneally, and two subcutaneously. All were killed after 97 days and showed chronic tuberculosis of the type usual after the inoculation of a Group II bacillus.

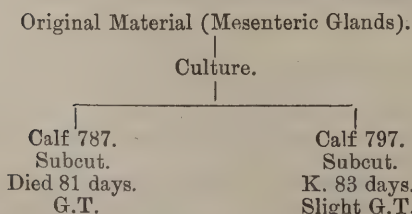
An earlier generation of this strain, i.e. the 11th, was also tested on rabbits; this culture had been preserved in a cupboard and was 253 days old, too old to obtain a culture direct from it; it was therefore inoculated into a guinea-pig and a culture was raised from the latter's tuberculous organs; the strain when 7½ weeks old was inoculated into a series of rabbits none of which developed progressive tuberculosis.

Cultural Characters.—The strain from Calf 265 and the two strains from Rabbit 181 grew luxuriantly on the differential media.

Summary.—The strains from Calf 265 and Rabbit 181 exhibited the cultural characters and virulence of the human tubercle bacillus.

VIRUS H 49. "T.C."

RECAPITULATION.



This virus was obtained from a youth aged 18 who died of tuberculosis of the lungs; several of the mesenteric glands were calcareous and as hard as a stone. A culture was obtained directly from the mesenteric glands; the attempt to obtain a culture from the lung failed.

The culture when two months old was inoculated subcutaneously into two calves in doses of 50 mg. each and intraperitoneally into rabbits; it gave rise in one of the calves (Calf 787) to fatal generalised progressive tuberculosis and in the other (Calf 797) to a limited retrogressive tuberculosis; it gave rise in the

rabbits to fatal general tuberculosis.

A culture obtained from the prescapular gland of Calf 797 (in which the original culture had produced only a limited retrogressive tuberculosis) when two months old produced fatal tuberculosis in two calves in a dose of 50 mg. and also in a dose of 10 mg.; it was fully virulent also for rabbits.

When nine months old, the original culture (7th subculture) failed to produce progressive tuberculosis in rabbits, and when 14 months old (14th subculture) produced in a calf in a dose of 50 mg. only a very limited retrogressive tuberculosis and in rabbits slight non-progressive tuberculosis.

The original culture, therefore, when tested soon after its isolation, exhibited a virulence somewhat below that of Group I; this virulence was increased by passage through the body of the calf to the level of a bovine tubercle bacillus and diminished by subculture on serum to the level of a human tubercle bacillus.

The original culture was, according to Dr. Cobbett, eugonic, and was placed by Dr. Eastwood in his Grade II.

RESULTS OF REINVESTIGATION.

Four strains of the virus were in existence, two from the original material which had been separately subcultivated, and those from Calves 787 and 797. All four strains were tested on rabbits and two on calves.

Virulence Tests.—The culture derived from the original material which had been cultivated by Cobbett in the Blythwood laboratory was tested after 20½ months' cultivation (21st generation). Six rabbits were inoculated, two intravenously, two intraperitoneally, and two subcutaneously. One died of pseudo-tuberculosis in 11 days; the others were all killed after 130 days and showed slight tuberculosis of a chronic type. Later on a culture of the 25th generation was inoculated subcutaneously into two calves (Calf 1191 and Calf 1193) and two rabbits (doses 50 and 100 mg.); the calves after 94 and 99 days had only slight retrogressive tuberculosis, and each of the rabbits after 142 days had a local lesion only.

The culture from the original material had been given shortly after its isolation to Dr. Eastwood, and had been subcultivated regularly on serum ever since at the Royalcot laboratory; in order to ascertain whether this strain had also lost its virulence, I obtained a culture from him and inoculated it into a series of three rabbits; the culture had then been 22½ months in cultivation and was the 25th generation. Two of the rabbits were inoculated intravenously and one intraperitoneally; the former died of general tuberculosis in 16 and 31 days respectively; the latter was killed after 163 days and showed chronic general tuberculosis, the injection having been partly intracoeal; the type of disease produced in the three cases was identical with that produced by a bovine tubercle bacillus.

The culture derived from Calf 787 was tested after 16 months' artificial cultivation. Six rabbits were inoculated, two intravenously, two intraperitoneally, and two subcutaneously. All died of general tuberculosis in from 14 to 90 days.

The culture derived from Calf 797 was also tested after 16 months' artificial cultivation. Six rabbits were inoculated, two intravenously, two intraperitoneally, and two subcutaneously. One intraperitoneal animal died in 12 days of acute tuberculosis, complicated with severe psorospermiosis of the liver; the others all died of general tuberculosis in from 13 to 80 days.

Cultural Characters.—The Blythwood strain of the original culture and a strain from each of the two calves inoculated with it (Nos. 1191 and 1193) grew well on glycerin media, as did also the Royalcot strain.

The two strains from Calf 787 and 797 did not grow so well as the strains from the original material, and resembled the more easy growing strains of bovine origin.

Summary.—The Blythwood strain of the original culture exhibited the cultural characters and virulence of a human tubercle bacillus: the Royalcot strain had the cultural characters of a human tubercle bacillus but resembled a bovine tubercle bacillus in virulence; the strains derived from Calves 787 and 797 were identical with bovine tubercle bacilli.

SUMMARY OF PRELIMINARY EXPERIMENTS.

Ten strains from the four viruses (H 13.“A.D.”, H 16.“J.H.”, H 17.“Sp.B.”, and H 49.“T.C.”), which during passage through the animal body underwent a change of character have been retested as to their cultural characters and virulence for rabbits.

Two strains from the virus designated H 2.“Sp. A.”, the original material of which was mixed sputum have also been retested [this virus was passed through a series of animals, and from some a slightly virulent, from others a virulent culture was isolated].

With two exceptions the cultural characters and the virulence of the twelve strains were found strictly in accordance; those strains which grew well on culture media had low virulence for rabbits, those which grew with difficulty were highly virulent for rabbits. The preliminary tests therefore gave no indication of the presence in any of these ten strains of two different kinds of organisms, and no further investigations with them were carried out. Whatever they had been they were now stable.

The first exception was the culture isolated from the mediastinal gland of Calf 301 (Virus H 13.“A.D.”), an animal which died of general tuberculosis after the subcutaneous inoculation (in passage) of an emulsion from the tuberculous organs of guinea-pigs; the culture was eugonic, and when tested by Dr. Cobbett after 15 months artificial cultivation produced in two rabbits slight chronic general tuberculosis, and in two calves inoculated with 50 milligrammes subcutaneously limited tuberculosis in one, and slight general tuberculosis in the other. When retested by me after a period of three years' artificial cultivation it grew luxuriantly on glycerin media, and produced in two calves generalised tuberculosis, not severe and not apparently progressive, and fatal general progressive tuberculosis in rabbits. It was more virulent therefore than when tested by Dr. Cobbett, but less virulent than a bovine tubercle bacillus.

The second exception was the culture derived directly from the mesenteric glands of a youth aged 18 (Virus H 49.“T.C.”). This culture had been cultivated in two different laboratories, in the Blythwood laboratory in charge of Dr. Cobbett and, since an early generation, in the Royalcot laboratory in charge of Dr. Eastwood. The former, called the Blythwood strain, had been tested by Dr. Cobbett two and seven months after isolation, and produced in calves and rabbits fatal general progressive tuberculosis; it was again tested 13½ months after its isolation and was found to have lost its virulence. The latter, or Royalcot strain, was tested by me when it had been in cultivation about two years, and was found to be virulent for the calf and rabbit, though not so virulent as a bovine tubercle bacillus. Both of the strains grew luxuriantly on artificial media, and were in this respect identical.

With these two exceptional strains further experiments were made (vide infra).

RESULTS OF THE SPECIAL INVESTIGATION OF TWO OF THE GROUP III. CULTURES [*H* 13. "A.D." (*CALF* 301), AND *H* 49. "T.C." (*O.M.*)] WHICH EXHIBITED EXCEPTIONAL FEATURES.

SEPARATION EXPERIMENTS.

INTRODUCTION.

The preliminary experiments with various strains of the viruses which had been placed in Group III. showed that two, *i.e.*, the Calf 301 strain of Virus *H* 13. "A.D." and the strain from the original material of Virus *H* 49. "T.C.", though they grew like the slightly virulent human tubercle bacillus, were nevertheless able to set up in rabbits generalised progressive tuberculosis. They behaved in fact like artificial mixtures of human and bovine tubercle bacilli.

For purposes of further investigation therefore they were assumed to be mixtures of this nature and attempts were made in each case to separate the component elements.

In an artificial mixture of human and bovine tubercle bacilli a separation of the two kinds of bacilli may be effected in three ways.

1. By passing the culture through the bodies of animals (*e.g.* calves and rabbits) which permit the multiplication of one kind of bacillus and resist that of the other.

2. By subculture on media containing a substance (glycerin) which is more favourable to the growth of one kind of bacillus than it is to that of the other.

3. By a method of plate culture.

All the three methods have been employed in the case of each strain.

The first method depends for its success on the fact that the bovine tubercle bacillus is able when inoculated subcutaneously to set up progressive tuberculosis in the calf and rabbit whereas the human tubercle bacillus (Group II.) is not so able.

In these animals after subcutaneous inoculation there is with both kinds of bacilli an initial dispersal all over the body but the human tubercle bacillus tends gradually to disappear while the bovine tubercle bacillus multiplies and gives rise to definite tuberculous lesions.

The human tubercle bacillus remains alive however in the tissues of the calf and rabbit for a long time and may conceivably be present within lesions produced by the bovine tubercle bacillus.

One passage through the animal body may not therefore be sufficient to eliminate entirely the possibility of cultivating the human tubercle bacillus along with the bovine unless the duration of life of the animal be long and the dose of slightly virulent bacilli be small.

The rabbit is more susceptible than the calf to the human tubercle bacillus and after subcutaneous inoculation of even moderate doses there may be a considerable number of tuberculous lesions in the lungs and kidneys, and since the lungs and kidneys are often the only organs affected in rabbits inoculated subcutaneously with bovine tubercle bacilli, elimination of the human tubercle bacillus in a mixture would be expected to be less certain in the rabbit than in the calf; and this experiment has shown to be the case. In the calf there is a greater range of lesions to choose from and the cultures can be raised from regions which only rarely show naked eye evidence of the presence of the human tubercle bacillus; it has been shown in several instances in this investigation that if glands (*e.g.*, the mediastinal and portal) are chosen which frequently show lesions after subcutaneous inoculation of human bacilli (Group II.) there exists the possibility of obtaining in a culture both kinds of bacilli together. Since one passage, either through the body of the calf or the rabbit could not be relied upon absolutely to eliminate the human tubercle bacillus the culture was in the majority of cases passed through more than one animal; in the case of the calves cultures were always isolated from distal lesions as well as the nearest gland.

While the method just described eliminates the eugonic element in a mixture, the second method—cultivation on glycerin media—is applied to eliminate the virulent element.

On glycerin media bovine tubercle bacilli grow, as a general rule, less well than the human tubercle bacillus, and in a culture containing both human and bovine tubercle bacilli would after several generations be expected to be finally overgrown. Many bovine tubercle bacilli, however, grow well on glycerin media, and all, even the most dysgonic, grow more luxuriantly when repeatedly subcultured on glycerin media.

The method would therefore fail to eliminate the bovine tubercle bacillus if the

latter were well adapted from the outset to grow on glycerin media. It might be at once successful, *i.e.*, after one subculture, if the bacillus grew very badly ; there is a certain class of bovine tubercle bacilli which begin to grow on glycerin serum apparently only during the second or third weeks, when they produce discrete colonies ; the portion of culture selected for the second glycerin subculture might within this period very easily not contain any of these colonies, and the strain would then be found to have lost its virulence ; but if the culture transplanted on to the second glycerin serum tube included any of the colonies, the bacilli which gave rise to them would tend not gradually to disappear but to be perpetuated, since the most dysgonic tubercle bacilli are improved in their growth capacity after one subculture on a glycerinated medium.

Subculture on glycerin media may be successful therefore, but cannot be relied upon in every case to eliminate the bovine bacillus in a mixture of human and bovine tubercle bacilli.

Dr. Cobbett used the method extensively, and was successful in eliminating the virulent element from an artificial mixture and from a natural mixture ; in both of his cases the virulent bacillus was a dysgonic bacillus.

Though the invariable replacement of a eugonic virulent strain by a dysgonic virulent strain by passage through the bodies of calves and rabbits, and though the complete loss or diminution of the virulence of the culture by growth on glycerin media would point strongly to the presence originally of two different kinds of bacilli, the only conclusive evidence of mixture would be furnished by the actual isolation from the culture, by means of plate culture, of strains with different and distinctive properties.

On account of the tendency of tubercle bacilli to adhere together in masses, and the impossibility of obtaining a homogeneous suspension, the application of the ordinary plate methods to a culture is only very rarely likely to be attended with success.

In a carefully prepared suspension of a culture there may be many single bacilli which may give rise to colonies, and these the investigator may be fortunate enough to select for investigation. But to determine whether or no a culture of tubercle bacilli is composed of one kind of bacillus involves a considerable amount of work—the culture must be tested, not only as to its characters on artificial media, but also as to its virulence for rabbits ; naked eye characters alone of colonies are not sufficient to differentiate between the bovine and human bacilli ; if a glycerin medium were used for the separation experiments, a small non-pigmented colony might probably be shown to be composed of virulent bacilli only, but it would be impossible, as the necessity for the present investigation shows, to say from cultural characters alone whether a culture which grows readily had not an admixture of dysgonic bacilli.

It was very important, therefore, in order to avoid unnecessary labour, that the bacilli in the material used for sowing the plates should be as isolated as possible. In emulsions of the tuberculous lesions of the guinea-pig, the isolation of individual bacilli, though not absolute, is very much greater than could possibly be secured by any method of emulsification of a culture.

In each case, therefore, the culture was inoculated into a guinea-pig, and the plates were sown with an emulsion made from its tuberculous tissues.

The guinea-pig is a most suitable animal for the purpose since it is almost equally susceptible both to the human and to the bovine tubercle bacillus, and the relative proportion of the two kinds of bacilli is not therefore likely to be seriously altered by the passage.

The medium used for the plates was bovine serum with the addition of 5 per cent. glycerin ; the glycerin was added in order to assist in the differentiation of the colonies, for on glycerinated serum the human tubercle bacillus grows generally with greater ease than the bovine bacillus, and often forms pigmented colonies.

The Petri dishes were filled to a depth of about 2 mm., and the serum was coagulated in the usual way ; after sowing, the plates were sealed with paraffin.

The method of separation was by surface cultivation, and plates were used merely for convenience and to secure as large a surface as possible ; large test-tubes containing glycerin serum were always sown at the same time as the plates, and in some instances colonies from these tubes were removed for investigation. The emulsion was diluted to an extent sufficient to secure isolated colonies, and spread thinly over the surface of the plates by means of a sterile camel's hair brush. It was found to be possible, however, to pour plates in the usual way. This was done in one case, but only one of the colonies produced was investigated : the medium used in this instance was agar with the addition of 10 per cent. serum ; the agar was melted and then cooled to 45° C. ; the serum and a loopful of the emulsion was then added, and the mixture poured into the plates.

VIRUS H 13. "A.D." (Calf 301 strain.)

SEPARATION BY ANIMAL INOCULATION.

(See Tables A and B.)

Calves.—Two calves were inoculated subcutaneously on March 23, 1907; one, No. 1177, with 50 milligrammes, the other, No. 1175, with 100 milligrammes of the culture derived from the mediastinal gland of Calf 301; the culture had then been three years two months in artificial cultivation and had been maintained during this period on pure serum with the exception of one generation which was grown on egg.

Both calves remained well and were killed in good health 81 and 110 days later respectively; they showed at the post-mortem examination generalised tuberculosis, not severe and not apparently progressive.

An emulsion of the caseous prescapular gland of Calf 1175 was prepared and 20 cubic centimetres inoculated subcutaneously into Calf 1237. The calf was killed when ill after 52 days and showed severe general tuberculosis.

Rabbits were inoculated subcutaneously with emulsions of tuberculous tissues from each of the first two calves, the prescapular, a mediastinal, and a popliteal gland in one case, the prescapular gland and the spleen in the other; all died of general tuberculosis in periods varying from 47 to 167 days.

Cultures were isolated from each of the three calves (1175, 1177, and 1237), from the prescapular gland as well as from metastatic lesions and from several of the rabbits; altogether eight strains from calves were investigated in culture and two from rabbits.

With one exception all the strains grew badly on artificial media; on glycerin serum growth was rather better than on serum alone, on glycerin agar a patchy grey layer was formed in which discrete colonies subsequently developed, on potato growth was thin

grey and uniform, and on broth thin incomplete and broken up into islands. The exceptional strain was obtained from one of the mediastinal glands of Calf 1175; this behaved like the original strain, growing well on artificial media and producing fatal general tuberculosis in rabbits; for the further investigation of this strain see under "Separation by Plate Cultures."

The strain derived by culture from the bronchial gland of Calf 1237, the second calf of the series, was inoculated subcutaneously in a dose of 50 milligrammes into Calf 1327 and in doses of 10 mg. into each of two rabbits; the calf died of miliary tuberculosis in 27 days and the rabbits of general tuberculosis in 37 and 68 days. This strain was identical with a bovine tubercle bacillus therefore both with respect to its cultural characters and its virulence.

Rabbits.—As has already been mentioned, a preliminary series of rabbits was inoculated with the Calf 301 strain to ascertain its virulence. All these animals died of general tuberculosis, and from two of them cultures were isolated; one of the rabbits, No. 1137, had been inoculated intravenously and the culture was obtained from the spleen; the other, No. 1140, had been inoculated subcutaneously and the culture was obtained from the lung. In each case the culture grew irregularly; on most of the tubes sown scanty growths were obtained, but, occasionally, more especially on potato, the growths were very good; the cultures behaved as if they were composed of poorly growing bacilli with a slight admixture of easy growing bacilli. Each culture when it had been in cultivation in one case 212 days, in the other 188 days, was inoculated subcutaneously into a rabbit. Both died of general tuberculosis, one in 62, the other in 29 days. The cultures isolated from these animals grew badly on all media and resembled precisely the poorly growing strains obtained from the calves.

Two rabbits were inoculated subcutaneously with the original culture at the same time as Calves 1175 and 1177, one with 50 mg., the other with 10 mg.; the former died in 28 days of general tuberculosis; the latter was killed when ill after 107 days and showed chronic general tuberculosis. A culture isolated from the latter animal was dysgonic and resembled the poorly growing strains isolated from the calves.

The result therefore was the same, whether the culture was passed through the body of the calf or of the rabbit, the eugonic element was eliminated and there was obtained a dysgonic fully virulent bacillus.

SEPARATION BY GLYCERIN MEDIA.

(See Table C.)

The original culture was subcultivated on glycerin serum for two generations, and then inoculated subcutaneously into a calf in a dose of 100 mg. and two rabbits in doses of 50 and 10 mg. Both rabbits died of general tuberculosis in 103 and 100 days respectively. The calf was killed after 92 days, and showed general tuberculosis very similar in extent and distribution to that produced in the two calves inoculated with serum culture. Four rabbits were inoculated with tuberculous tissues from this calf, two from the prescapular gland, and two from a mediastinal gland; one of each pair died prematurely; the other two died of general tuberculosis in 92 and 53 days respectively.

Cultures were isolated from the prescapular gland and a mediastinal gland of the calf and from a rabbit inoculated with the prescapular gland. All the strains grew poorly on glycerin media in spite of the fact that they had resided for two generations on glycerin serum.

Subculture on glycerin serum therefore failed to eliminate the virulent element from the culture; the virulence was nevertheless reduced, as shown by the long duration of life of the two rabbits inoculated subcutaneously.

SEPARATION BY PLATE CULTURES.

(See Tables D, E, and F.)

To furnish material for sowing the plates, a guinea-pig, No. 2491, was inoculated intraperitoneally with an emulsion of a large colony from an egg tube sown with the Calf 301 strain; the colony was 205 days old. The guinea-pig was killed 25 days later and found to have early general tuberculosis; an emulsion was made from a caseous sternal gland, and spread over the surface of glycerin serum plates with a camel's hair brush.

After several weeks incubation the plates were removed from the incubator and examined; they were found to be covered with growth which in the main consisted of two quite distinct kinds of colonies; one kind

was small and grey and not pigmented, the other was large yellow and wrinkled, spreading in some cases up the sides of the plate.

Eight of the large colonies and two of the small ones were separately subcultivated on glycerin serum. These strains after subculture were tested on rabbits and on the differential media.

The strains raised from the two small colonies (Colonies 4 & 5) were highly virulent for rabbits, and grew poorly on the differential media; one (Colony 5) was inoculated subcutaneously in a dose of 50 mg. into a calf (1309) which died of acute tuberculosis in 30 days. Both these strains therefore were identical with a bovine tubercle bacillus.

The strains from the large colonies grew more luxuriantly than those from the small colonies on all the media used; on serum they produced a yellow pigment, on potato and agar some of the strains grew very abundantly, others only moderately well. Each of the strains was tested on rabbits subcutaneously; the doses were not estimated, but were in every case very large, consisting of the whole or half of the growth on a large glycerin serum tube.

Three of the rabbits, Nos. 1516, 1519, and 1521, inoculated respectively with culture from Colonies 3, 6, and 8, had when killed 160 days later besides a local lesion only slight tuberculosis of the lungs and one or two tubercles in the kidneys. The amount and extent of the disease in these animals were not greater than might have been produced by a Group II. bacillus, but on the other hand they were not less than might have been produced by a small dose of a Group I. bacillus.

In order, therefore, to ascertain whether the particular strains used for these rabbits were composed of one kind of organism only, it was necessary to isolate and test cultures from metastatic lesions. A culture was accordingly raised from the lung of each of the three rabbits (1516, 1519, and 1521). These cultures grew well on the differential media, and were inoculated intravenously into two rabbits in doses of 0.1 and 0.01 mg.

The results showed that in the cultures inoculated there were no bacilli capable of giving rise to progressive tuberculosis in the rabbit.

The three colonies were composed solely therefore of eugonic slightly virulent bacilli.

The other five strains (from Colonies 1, 2, 7, 9, and 10) each produced in the rabbit progressive tuberculosis and from the lesions in two of the rabbits dysgonic bacilli were isolated.

Two of the colonies (Colonies 2 and 9) were retested, the former on a calf (Calf 1301) and two rabbits, the latter on a series of three rabbits. The animals in each series died of general tuberculosis, and from the portal gland of the calf (Colony 2 strain) and from one of the rabbits inoculated with Colony 9 strain, dysgonic cultures were isolated.

These five strains resembled therefore the original culture.

In the event that the experiments with the strains from Guinea-pig 2491 were not successful in separating the virulent from the eugonic element, an emulsion made from one of the large colonies (Colony 11) on a plate sown from Guinea-pig 2491 was inoculated intraperitoneally into Guinea-pig 2605 and plate cultures were sown with emulsions made from the omentum and spleen; a rabbit inoculated subcutaneously at the same time as the guinea-pig died of general tuberculosis. A culture was raised on egg in the ordinary way from the omentum and spleen of the guinea-pig; these strains grew luxuriantly on artificial media and produced general tuberculosis in a series of two and four rabbits; the duration of life was however longer than in rabbits inoculated with equivalent doses of a bovine tubercle bacillus.

Numerous colonies appeared on all the plates but on one, sown from the omentum, they were sufficiently discrete to enable one to pick off separate colonies. The colonies were of two kinds; some were small, flat, and of a greyish colour, the others were a little larger, more raised, and of a canary yellow colour.

Eleven colonies, four grey and seven yellow, were selected and separately subcultivated. On glycerin potato three of the strains from grey colonies grew poorly, the fourth grew well; all the strains from yellow colonies produced thick wrinkled pigmented growths.

One of the strains from a grey colony (Colony 4) and five from yellow colonies (Colonies 6, 7, 8, 9, and 10) were inoculated each into two rabbits intravenously.

The two rabbits inoculated with the Colony 4 strain died of miliary tuberculosis in 18 and 28 days; this strain was therefore dysgonic and fully virulent.

Two of the strains, raised from the yellow Colonies 8 and 10, produced progressive tuberculosis in rabbits; they resembled therefore the original culture.

The three remaining strains from the yellow Colonies 6, 7, and 9 were inoculated each into two rabbits; one died in 69 days and showed slight tuberculosis of the lungs and kidneys; the other five remained well and when killed in from 104 to 119 days showed the type of tuberculosis commonly met with after the intravenous inoculation of slightly virulent human tubercle bacilli. Two of these strains, from Colonies 6 and 7, were each inoculated subcutaneously into a calf, one in a dose of 59 mg., the other in a dose of 78 mg.; they were killed 76 and 84 days later respectively and each showed a local lesion and tuberculosis of the nearest glands only (in one of the calves there was a doubtful focus in a bronchial gland and a doubtful tubercle in the lung).

The emulsion from the omentum of Guinea-pig 2605 was also plated in the way ordinarily used for separating the commoner organisms. The medium used was agar, to which had been added 10 per cent. serum. Sparsely scattered colonies were obtained on all the plates, some growing on the surface, some in the depth; one of the surface colonies was removed and separately cultivated; the culture grew luxuriantly on glycerin media; three rabbits (Nos. 1777-1779) were inoculated with it, two intravenously and one subcutaneously. The results showed that the culture was composed of the slightly virulent type of bacillus only.

The investigation of the strains from Guinea-pig 2605 has shown therefore that of the seven tested in culture and by inoculation one was dysgonic and virulent and resembled a bovine tubercle bacillus, four were eugonic and slightly virulent and resembled a human Group II bacillus, and two were eugonic and virulent and were like the original culture.

The culture isolated from the mediastinal gland of Calf 1175 closely resembled the original culture—it grew well on glycerin media and was virulent for rabbits—and an attempt was made by means of plate cultures to separate a eugonic slightly virulent bacillus and a dysgonic virulent bacillus.

A guinea-pig (No. 2621) was inoculated with a 70 days' old glycerin serum culture and large tubes of glycerin serum were sown from its tuberculous spleen and sternal gland. On these tubes two kinds of colonies could be distinguished, grey and yellow. Four of the yellow colonies and two of the grey were taken and separately subcultivated.

After several subcultures on serum the four strains from yellow colonies (Colonies 1, 2, 3, and 4) were inoculated into rabbits, the two former intravenously each into two rabbits and the two latter subcutaneously each into one rabbit. The first two colonies produced progressive tuberculosis in rabbits; the two rabbits inoculated with the other two colonies died prematurely in 56 and 41 days and showed slight tuberculosis.

The two strains from grey colonies (Colonies 5 and 6) inoculated each into a rabbit subcutaneously, produced fatal general tuberculosis identical with that produced by a bovine tubercle bacillus.

The culture raised in the ordinary way from the spleen of Guinea-pig 2621 was eugonic and virulent.

From each of three different strains of the Calf 301 culture therefore, cultures raised from separate colonies have been obtained which are identical some with a bovine tubercle bacillus, others with a human tubercle bacillus.

VIRUS H 49. "T.C." (Strain from the original material.)

SEPARATION BY ANIMAL INOCULATION.

(See Tables G, H, and I.)

Culture from O.M.
(Royalcot strain.)
|
Calf 1213.
Subcut.
50 mg.
K. 80 days.
Chronic G.T.
|
Calf 1263.
Subcut.
E. of Prescap. Gland.
K. 91 days.
Chronic G.T.
|
Culture from thoracic gland.
|
Calf 1347.
Subcut.
50 mg.
K. (ill) 52 days.
Severe G.T.

Calves.—Calf 1213 was inoculated subcutaneously with 50 mg. of the original culture; the strain had then been 746 days in artificial cultivation, and had been maintained during this time on serum alone; a series of four rabbits was inoculated at the same time as the calf. The calf was killed in good health 80 days after inoculation, and showed general progressive tuberculosis of a chronic type. All the rabbits developed fatal general tuberculosis, but the duration of life was prolonged as compared with that of rabbits inoculated with bovine tubercle bacilli.

An emulsion was prepared from the enlarged caseous prescapular gland of Calf 1213, and inoculated subcutaneously into Calf 1263; two rabbits were also inoculated subcutaneously with the prescapular gland emulsion, and two with an emulsion made from a mediastinal gland.

The calf was killed in good health 91 days after inoculation, and showed chronic general tuberculosis, the lungs being covered with "perlsucht" growths; all the rabbits developed generalised progressive tuberculosis.

Two rabbits were inoculated subcutaneously with tuberculous tissues from Calf 1263, one with an emulsion of the prescapular gland, the other with an emulsion from a portal gland; the latter died prematurely, the former was killed after 232 days and showed chronic progressive tuberculosis.

Cultures were isolated from each of the two calves, 1213 and 1263, from the prescapular gland as well as from distal lesions.

The strain from the mediastinal gland of Calf 1213 grew luxuriantly on broth, and moderately well on the other media. The other strains from this calf, as well as all those from Calf 1263 grew much less well than the original strain, and were indistinguishable from a bovine tubercle bacillus.

The culture derived from the mediastinal gland of Calf 1263 was tested subcutaneously on a calf in a dose of 50 mg., and on two rabbits in doses of 10 and 7.3 mg.

The calf (1347) was killed when ill 52 days after inoculation and showed generalised progressive tuberculosis; the rabbits died in 74 and 78 days respectively of general tuberculosis.

The culture obtained from the prescapular gland of Calf 1213 was also tested on rabbits; twelve colonies were taken from an egg tube and separately cultivated for three generations; the growth from one serum tube in the case of each strain was then inoculated subcutaneously into a rabbit; nine of the rabbits died in from 23 to 91 days of general tuberculosis, the other three were killed after 108 days, and all showed generalised progressive tuberculosis.

Rabbits.—Cultures were isolated from two of the three rabbits inoculated to test the virulence of the original strain. One of the rabbits, No. 1181, died 31 days after an intravenous inoculation of 0.1 mg., and cultures were obtained from the lung and a kidney; the other rabbit (No. 1182) had been inoculated intraperitoneally with 1.0 mg. of culture, and died of general tuberculosis in 106 days, the long duration of life being due to the fact that the injection was partly subcutaneous; the culture in this case was taken from a pleural nodule.

The culture from the latter rabbit was dysgonic and resembled the strains from the calves.

The cultures from the other rabbit (Rabbit 1181) were irregular in their growth; on potato for example very good growths were occasionally obtained, while on other media the growths were usually poor.

An emulsion of the lung of Rabbit 1181 was inoculated subcutaneously into two rabbits; both animals died of general tuberculosis, one in 74, the other in 82 days. A culture isolated from the scapular gland of one of the rabbits, No. 1219, was dysgonic and resembled the strains from the calves.

By passage through the body of the calf, as well as through that of the rabbit therefore the eugonic element in the culture has been eliminated, and a dysgonic virulent culture obtained.

SEPARATION BY GLYCERIN MEDIA.

(See Table J.)

A separation of the virulent element from the easy growing element by means of glycerin was effected unwittingly. A good growth had been obtained on a tube of glycerin agar and with the object of securing a preponderance of easy growing bacilli in the material for sowing plates this culture was used to inoculate a guinea-pig, No. 2490.

The guinea-pig developed tuberculosis and plates of glycerin serum were sown with an emulsion made from the caseous sternal gland.

Colonies were obtained sufficiently discrete and subcultures were made from twelve; the colonies varied in size but not in type and a selection was made of large and small.

After two subcultures on serum the strains were tested on glycerin potato; the growths produced on some of the potatoes were very good, on others poor. This preliminary test seemed to indicate that a separation of a dysgonic and a eugonic bacillus had been effected. Six of the strains, representing both easy growing and poorly growing strains were therefore tested on rabbits, one rabbit being inoculated subcutaneously with one serum culture of each strain. All the rabbits remained well and when killed in periods varying from 94 to 99 days showed slight and retrogressive tuberculosis only; in each rabbit there were some miliary tubercles in the lungs and in two very slight tuberculosis of the kidneys. Cultures were isolated from each one of these animals, four being isolated from lungs, three from local lesions and one from a scapular gland. All the strains were eugonic. The scapular gland culture was tested on two rabbits intravenously and found to be only slightly virulent.

Subsequently four more of the twelve strains were tested on rabbits, two intravenously and two subcutaneously, and three of the six that had been inoculated subcutaneously were retested intravenously, each on two rabbits. The results in all these rabbits showed that the strains had only slight virulence.

Strain 9 was also inoculated into a guinea-pig (No. 2816) and cultures were obtained from the spleen and sternal gland. Both strains grew well and the spleen strain had only slight virulence for the rabbit.

When it was realised that all the colonies isolated from Guinea-pig 2490 were of one type and only slightly virulent for the rabbit the culture obtained from the guinea-pig in the ordinary way *i.e.* by scraping the surface

of an egg tube, and arising therefore from a number of colonies, was inoculated into a series of four rabbits, three intravenously and one subcutaneously. None of the rabbits developed fatal tuberculosis, the disease produced in all being consistent with the inoculation of a Group II. bacillus.

It is clear from these experiments that there were no virulent bacilli in the culture inoculated into the guinea-pig and that subculture on a medium containing glycerin had resulted in the elimination of the virulent element from the virulent eugonic culture.

The experiments show further that size of colony alone cannot be relied upon as a means of differentiating two kinds of organisms

SEPARATION BY PLATE CULTURES.

(See Tables J and K.)

As has already been described the first attempt to separate different types of bacilli from the culture by means of plate cultures was unsuccessful; it had failed because cultivation on a glycerin medium had caused the elimination of the virulent element.

In a second experiment I started with a culture which had not been subjected to the influence of glycerin.

The culture in its 35th generation (2 years, 11 months old) was inoculated intraperitoneally into Guinea-pig 2918, and a generation later was tested on a series of four rabbits (see Table G) in order to see whether the original culture maintained on serum had retained its virulence; all the rabbits died of general tuberculosis, the duration of life being a little prolonged as compared with that after the inoculation of bovine tubercle bacilli.

The guinea-pig died in 14 days of tuberculosis, and emulsions were made from the sternal gland and spleen. Four glycerin serum plates were sown with the emulsions as well as a number of egg tubes and large glycerin serum tubes.

Numerous colonies grew on the tubes while on the plates the colonies were very sparsely scattered; they varied in size but did not differ in any other respect.

A subculture made in the ordinary way from an egg tube produced luxuriant growths on the glycerin media.

Eighteen colonies, twelve from the plates and six from the glycerin serum tubes, were taken and separately subcultivated on serum; after four subcultures all the strains were tested on glycerin potato in order to gain a preliminary impression as to the properties of the strains.

Five of the strains grew very well, producing yellow wrinkled or warty layers; of the rest, some grew very poorly, while the others produced intermediate amounts of growth.

Four of the eugonic and one of the dysgonic strains were selected for inoculation into animals.

Each strain was inoculated intravenously into a series of three rabbits.

Two of the eugonic strains (from Colonies 5 and 7) produced slight retrogressive tuberculosis in rabbits. Fifty milligrammes of culture from Colony 7 produced in a calf (Calf 1415) inoculated subcutaneously local tuberculosis only. These two strains therefore contained no virulent bacilli.

The other two eugonic strains (from Colonies 3 and 13) produced fatal general tuberculosis in all the rabbits inoculated, and one of them (from Colony 3) gave rise in a calf (Calf 1387) inoculated subcutaneously with 50 mg. to general tuberculosis fatal in 58 days. These two strains exhibited therefore the properties of the original culture.

The dysgonic strain (from Colony 17) produced rapidly fatal general tuberculosis in all the rabbits inoculated. It was also inoculated subcutaneously into two calves in doses of 50 mg. (Calf 1413) and 48 mg. (Calf 1501). The former was killed after 107 days and showed slight retrogressive general tuberculosis, the latter died in 45 days of general tuberculosis.

Thus by the use of the plate method of separation strains of tubercle bacilli with the properties of the human and of the bovine tubercle bacillus respectively have been isolated from the H 49. "T.C." culture.

SUMMARY AND CONCLUSION.

The second part of this report is concerned with two cultures—H 13. "A.D." Calf 301 strain, and H 49. "T.C." strain from the original material (mesenteric gland)—which had been shown to possess in common the capacity to grow luxuriantly on artificial media and to produce general progressive tuberculosis in calves and rabbits.

Each of the cultures has been specially investigated with the object of ascertaining whether the want of that accordance which usually obtains between cultural characters and virulence was due to a mixture of bacilli, with the properties of the human and the bovine tubercle bacillus respectively.

To each culture, three methods of separation have been applied, viz.:—(1.) Animal inoculation: (2.) Cultivation on glycerin media: (3.) Plate cultivation.—With the following results:—

By passage through the bodies of calves and rabbits the eugonic element in each culture has been eliminated, the culture finally obtained being dysgonic and virulent.

Cultivation on glycerin media has been successful in eliminating the virulent element in one case only, H 49. "T.C."; in this case a eugonic slightly virulent culture was obtained after one subculture on glycerin agar.

By means of plate culture, dysgonic virulent strains and eugonic slightly virulent strains have been obtained at one and the same time, from each of the two cultures.

The experiments show conclusively therefore, that each of these cultures is a mixture of two kinds of organisms, one with the properties of the bovine tubercle bacillus, the other with the properties of the human tubercle bacillus.

RESULTS OF THE SPECIAL INVESTIGATION OF THE TWO CULTURES H 60. "W.B." (bronchial gland) and H 90. "I.P." (retroperitoneal gland), ISOLATED SINCE THE SECOND INTERIM REPORT, WHICH EXHIBITED THE FEATURES OF THE TWO GROUP III. CULTURES.

SEPARATION EXPERIMENTS.

SUMMARY OF RESULTS.

Among the strains of culture isolated from human tuberculous lesions and investigated since the issue of the second interim report there were two which displayed the peculiarity of the two Group III. cultures [H 13. "A.D." (Calf 301) and H 49. "T.C." (mesenteric gland—Royalcot strain)] of which the results of the reinvestigation are given in the second part of this report.

This peculiarity was the association of high cultural luxuriance with the power to set up general progressive tuberculosis in calves and rabbits when inoculated subcutaneously.

The cultures (*i.e.* the bronchial gland strain of Virus H 60. "W.B." and the retroperitoneal gland strain of Virus H 90. "I.P.") were investigated therefore in exactly the same manner as the two above-mentioned Group III. cultures, with the object of ascertaining whether or no their exceptional properties were due to the association of virulent tubercle bacilli with eugonic slightly virulent tubercle bacilli.

The culture from Virus H 60. "W.B." was isolated from a guinea-pig which had been inoculated with an emulsion of the caseous bronchial glands of a child aged four years and seven months who died of general miliary tuberculosis. The culture was equal in virulence to a bovine tubercle bacillus, producing fatal general tuberculosis in calves after subcutaneous inoculation, but grew more readily on artificial media than bovine tubercle bacilli. Cultures from the meninges, lung, and mesenteric gland of the child grew luxuriantly on glycerin media and were only slightly virulent for calves and rabbits.*

The strain of Virus H 90. "I.P." investigated was obtained directly from the retroperitoneal gland of a man aged 70 who died of pneumonia. The culture grew luxuriantly on artificial media like the human tubercle bacillus; it produced in calves slowly progressing tuberculosis not severe and not fatal within the period of observation, and in rabbits progressive tuberculosis not so quickly fatal as after the inoculation of equivalent doses of bovine tubercle bacilli. The culture was therefore not so virulent as the H 60. "W.B." strain. A culture isolated from the mesenteric gland of the same patient through the guinea-pig also grew luxuriantly, but was only slightly virulent for the rabbit.

Cultures obtained from distal lesions produced in the rabbits as well as the calves inoculated with the original strains (H 60. "W.B." bronchial gland, and H 90 "I.P." retroperitoneal gland) grew with difficulty on artificial media and were fully virulent; the capacity to grow luxuriantly therefore was lost by both cultures in their passage through the bodies of the calf and rabbit, and bacilli were obtained which exactly resembled bovine tubercle bacilli in cultural characters and virulence.

* Dr. Eastwood who tested the cultures shortly after their isolation found that the bronchial gland strain did not grow so well as the other three. Dr. Cobbett produced luxuriant growths on agar and glycerin serum with the 2nd generation of the bronchial gland strain. When I tested them after 10 months cultivation all the strains grew equally well on the glycerin media.

With a culture which inoculation tests showed to be largely composed of virulent bacilli it is not surprising that irregular results were at first obtained on artificial media; in this case long cultivation had apparently favoured the multiplication of the easy growing bacilli in the culture and their increased proportion then rendered it impossible to distinguish the culture from the other strains of the same virus.

Results similar to these had been obtained by passage through the animal body with the two Group III. cultures (H 13 and H 49) and with artificial mixtures of human and bovine tubercle bacilli (*see* Reports 5 and 6 in this Volume).

Attempts were made therefore to separate by means of the plate method of cultivation used for the Group III. cultures, the two kinds of tubercle bacilli of which the cultures under consideration were apparently composed.

These separation experiments were successful, and strains of culture raised from single colonies were obtained from each of the two cultures which corresponded exactly on the one hand to the human tubercle bacillus and on the other to the bovine tubercle bacillus.

The results showed conclusively therefore that the bronchial gland strain of H 60. "W.B." and the retroperitoneal gland strain of H 90. "I.P." were mixtures containing bovine and human tubercle bacilli.

Attempts were also made to eliminate the virulent bacilli from the cultures by growing them for a period on a medium containing glycerin.

After subculture on glycerin-serum both cultures were still virulent for rabbits ; in both cases, however, the virulence was reduced. The failure to eliminate the virulent bacilli by this means was due to the fact that the virulent bacilli grew on glycerin serum fairly readily.

The details and results of the experiments with each culture are set out under the three headings "Separation by Animal Inoculation," "Separation by Glycerin Media," and "Separation by Plate Cultures."

A. STANLEY GRIFFITH.

VIRUS H 60. "W.B." (Bronchial gland strain.)

SEPARATION BY ANIMAL INOCULATION.

(See Tables L and M.)

Calves.—Calf 1099 was inoculated subcutaneously with 50 mg. and Calves 1107 and 1109 each with 10 mg. of culture derived from the bronchial gland of H 60. W.B. through guinea-pig 1825.

The first calf died of severe generalised tuberculosis in 28 days; the other two died of generalised tuberculosis in 58 and 32 days respectively.

Cultures were isolated from the spleen of Calf 1099 and from the prescapular and portal glands of Calf 1107.

The strain from Calf 1099 grew well on some media, particularly on potato, on which it produced a layer indistinguishable from that produced by a Group II. bacillus. The strains from Calf 1107 were dysgonic.

Rabbits.—Cultures have been isolated from a number of rabbits inoculated at various times to test the virulence of the bronchial gland strain.

The first, No. 908, inoculated intraperitoneally with 1 mg., died in 33 days of general tuberculosis; the culture isolated from the lung grew poorly on most media but well on potato; it probably contained a small proportion of eugonic and a large proportion of dysgonic bacilli.

The second, No. 951, inoculated intraperitoneally with 1 mg., was killed after 103 days and found to have general tuberculosis; the culture isolated from a kidney was dysgonic.

The third, No. 935, inoculated intraperitoneally with 0.1 mg., died of general tuberculosis in 82 days; a culture isolated from it was dysgonic. A few small colonies appeared on a glycerin serum tube, and it was thought that these might be composed of eugonic slightly virulent bacilli only; one of the colonies therefore when it was 31 days old was removed and inoculated intraperitoneally into Rabbit 1017; this rabbit died of general tuberculosis in 32 days; cultures were again obtained on a glycerin serum tube, and a single colony was emulsified and inoculated subcutaneously into Rabbit 1121; this rabbit died in 112 days of general tuberculosis, and a culture isolated from it was dysgonic.

Passage through the bodies of calves as well as rabbits had eliminated the eugonic bacilli in the culture

SEPARATION BY GLYCERIN MEDIA.

(See Tables M and N.)

Cobbett attempted by means of glycerin serum to separate the eugonic bacillus from the virulent bacillus when these had been properly mixed. He took a single colony from a glycerin serum tube, subcultivated for three generations, and then inoculated two rabbits (Nos. 949 and 950) intraperitoneally, each with 1 mg.; one died in 31 days of general tuberculosis, the other was killed after 103 days and showed general progressive tuberculosis, the long duration of life being due to the intracoeal inoculation of some of the dose.

From each of these rabbits I isolated a culture; the cultures made in the usual way, by scraping the surface of an egg tube, were dysgonic. Numerous colonies were obtained on a glycerin serum tube sown from Rabbit 949; since one does not commonly get a good primary growth of virulent bacilli on glycerin serum it was thought that these colonies might be the product of slightly virulent bacilli; one colony was selected, emulsified, and inoculated intraperitoneally into a rabbit (No. 1018); this animal died in 30 days of miliary tuberculosis. Numerous colonies were again obtained on glycerin serum, and when 36 days old, one was removed, emulsified and inoculated subcutaneously into Rabbit 1120; this rabbit died in 246 days of general tuberculosis and a culture obtained from it was dysgonic.

Another attempt was equally unsuccessful. The culture, when it was 10 months old (10th generation) and had been grown for two generations on glycerin media, was inoculated intraperitoneally into two rabbits, each rabbit receiving half a glycerin serum culture; the rabbits died of general tuberculosis in 109 and 128 days respectively.

The same strain was subcultivated on serum for two more months and then inoculated into a calf (Calf 1203) in a dose of 48 mg., and into a series of four rabbits. The calf was killed when well after 97 days and showed general tuberculosis of a retrogressive character; all the rabbits died of general tuberculosis, but the duration of life was longer than in rabbits inoculated with equivalent doses of bovine tubercle bacilli. The residence on glycerin media had diminished but had not eliminated the virulence of the culture.

From one of the egg tubes sown with an emulsion from the prescapular gland of the calf (1203), 12 single colonies were taken and separately subcultivated on serum; after two generations on serum each strain was inoculated subcutaneously into a rabbit. One rabbit died prematurely; all the others developed generalised progressive tuberculosis.

Two rabbits were inoculated subcutaneously with emulsions of tuberculous tissues from Calf 1203, one from the prescapular gland and one from a bronchial gland; they died of general tuberculosis in 138 and 111 days respectively. The cultures isolated from the prescapular gland, a bronchial gland, and the spleen of the calf were all dysgonic.

Subculture on glycerin serum, therefore, failed in this case to eliminate the virulent bacillus.

SEPARATION BY PLATE CULTURES.

(See Table O.)

Glycerin serum plates were sown with an emulsion of the caseous sternal gland of a guinea-pig, No. 2489, which had been inoculated intraperitoneally with the bronchial gland strain of H 60. W.B.; the guinea-pig was killed 16 days after inoculation and showed early general tuberculosis.

The plates were incubated for several weeks and only six colonies altogether developed; three of these were large, one was small, and two were of intermediate size. Separate subcultures were made on glycerin serum from each of the six colonies, and after 19 days' cultivation, the whole of the growth from one tube was, in the case of each strain, inoculated subcutaneously into a rabbit; the growths were better on some tubes than on others and therefore the doses varied.

One of the rabbits (strain from Colony 2) died in 11 days from causes other than tuberculosis, two (strains from Colonies 5 and 4) died in 53 and 96 days of general tuberculosis; the others (strains 6, 1 and 3) were killed 99 days after inoculation; one had chronic general tuberculosis, another had a local lesion and slight retrogressive tuberculosis of the lungs, and the remaining one had a local lesion only.

Later on, three of the strains, those from Colonies 2, 5 and 1, were retested on rabbits; in each case two rabbits were inoculated intravenously, one with 0.1 mg., the other with 0.01 mg.; the two rabbits inoculated with the strain from Colony 5 which had when first tested produced general tuberculosis in the rabbit inoculated subcutaneously, died in 42 and 67 days of general tuberculosis; the remaining four (inoculated with strains 2 and 1) were killed 128 days later and showed a very limited retrogressive tuberculosis.

In the event that it were found that none of the eugonic strains was composed solely of slightly

virulent bacilli, one of the strains, that from Colony 1, was inoculated into a guinea-pig (No. 2817) and plate cultures were made from its tuberculous organs. On all the plates numerous colonies appeared; they were of one kind and grew to a large size. Separate colonies were not investigated since the result of the first experiment, which by this time had been ascertained, left little room for doubt that the strain was a pure culture of slightly virulent bacilli. A culture obtained from the guinea-pig in the ordinary way but cultivated throughout on glycerin serum had slight virulence only for the rabbit and grew luxuriantly on the differential media.

Two of the strains, those from Colonies 1 and 5, were subsequently inoculated subcutaneously each into a calf (dose 50 mg.) and into rabbits. The strain from Colony 1 which grew luxuriantly on artificial media produced slight retrogressive tuberculosis in the calf (Calf 1481) and the rabbits; the strain from Colony 5, which grew poorly on artificial media, gave rise to fatal generalised progressive tuberculosis in the calf (Calf 1425) and the rabbits.

The inoculation experiments with the six strains showed therefore that three of the strains were virulent and three slightly virulent for the rabbit. The three slightly virulent strains (from Colonies 1, 2, and 3) grew well on artificial media and resembled therefore a Group II. bacillus; two of the virulent strains (from Colonies 4 and 5) grew poorly and resembled exactly a bovine tubercle bacillus; the other virulent strain (from Colony 6) grew well and resembled the original culture.

An unsuccessful attempt was made to separate a eugonic and a dysgonic bacillus from the original culture directly; an emulsion of the culture was made, diluted, and sown over the surface of glycerin serum plates. Ten single colonies were chosen, separately subcultivated on serum, and then tested on rabbits; in the case of each strain a rabbit was inoculated subcutaneously with the growth from one serum tube. Three of the rabbits died prematurely, four died of general tuberculosis.

SUMMARY.

From the culture derived from the bronchial gland of Virus H 60. "W.B." the eugonic element was eliminated by passage through the bodies of calves and rabbits, and there remained a dysgonic fully virulent bacillus; and by means of the plate method of cultivation strains of culture have been obtained with the properties of the human and the bovine tubercle bacillus respectively.

VIRUS H 90. "I.P." (Retroperitoneal Gland Strain.)

SEPARATION BY ANIMAL INOCULATION.

(See Tables P, Q and R.)

Calves.—Two calves were inoculated subcutaneously when the culture had been 340 days in artificial cultivation, one calf (No. 1383) receiving 50 milligrammes, the other (No. 1471) 80 milligrammes. They were killed in good health 92 and 90 days respectively after inoculation and showed generalised tuberculosis not severe but obviously progressive.

Cultures were isolated from the lung, spleen and a pudic gland of Calf 1383 and the prescapular gland and a bronchial gland of Calf 1471.

All the strains were identical in their cultural characters and resembled the more difficultly growing bovine viruses; they produced on serum glycerin-serum and potato thin grey layers, and on agar very scanty growths.

The strain from the pudic gland of Calf 1383 produced in a calf inoculated subcutaneously with 50 milligrammes generalised progressive tuberculosis fatal in 42 days.

The strain from the bronchial gland of Calf 1471 inoculated subcutaneously into a calf in a dose of 45 milligrammes produced generalised tuberculosis fatal in 21 days.

After passage through the calf therefore, the easy growing bacilli in the culture inoculated were eliminated and there remained dysgonic virulent bacilli identical in every respect with bovine tubercle bacilli.

Rabbits.—Cultures have been recovered from four of the rabbits inoculated with the original strain.

Two of the rabbits were killed 111 days after subcutaneous inoculation with 10 milligrammes of culture, and showed general progressive tuberculosis. Cultures were isolated from the scapular gland and a kidney of one (No. 1553) and from one of the kidneys of the other (1554); the two strains from the kidneys grew poorly on glycerin, that from the scapular gland produced pigmented layers on serum and a yellow wrinkled layer on potato; the strain from the scapular gland therefore still contained eugonic bacilli while those from the kidneys were purely dysgonic.

The other two cultures were obtained from two rabbits which had been inoculated intravenously one with 0.1, the other with 0.01 milligramme.

One of the rabbits (No. 1794, dose 0.1 mg.) died of general tuberculosis in 64 days and the culture was obtained from the lung, the other (No. 1795, dose 0.01 mg.) died of general tuberculosis in 116 days and the culture was obtained from the kidney.

The strain from the kidney of rabbit 1795 was dysgonic, that from the lung of rabbit 1794 was lost before its cultural characters had been determined.

Both strains were tested on rabbits and found to be fully virulent.

Passage through the rabbit therefore had the same effect on the culture as passage through the calf:—the eugonic bacilli were eliminated and dysgonic virulent bacilli alone remained.

Goat.—The retroperitoneal gland strain was at first thought to be a pure culture of slightly virulent bacilli like the strain from the mesenteric gland and in this belief it was used in a good many experiments made to compare the effects of slightly virulent and virulent bacilli.

One of these experiments was with a goat which was inoculated subcutaneously with the object of ascertaining whether human tubercle bacilli are excreted in the milk of an animal after subcutaneous inoculation.

The goat received 50 milligrammes of a glycerin serum culture under the skin of the neck and was killed 103 days later.

The milk of the goat withdrawn at intervals of 24 hours during the first eight days and then on the 14th, 21st and 75th days after her inoculation produced tuberculosis in guinea pigs, and from one of these guinea-pigs (one inoculated with the 14th day milk) a culture was isolated; this culture grew well on artificial media and had low virulence for the rabbit.

The post-mortem examination of the goat showed a small local lesion, caseous nodules in the adjacent prescapular gland, a number of small grey tubercles in the lungs and one in each kidney, soft yellow tubercles in the mesenteric glands, and several miliary fibro-caseous tubercles in the mamma.

An emulsion of the prescapular gland was inoculated subcutaneously into two rabbits both of which died of general tuberculosis one in 145 the other in 157 days, and a culture was isolated from the lung of each. Both cultures were dysgonic and one was shown to be fully virulent for the rabbit.

The culture raised directly from the prescapular gland was eugonic and after 301 days artificial cultivation was found to be slightly virulent for rabbits.

The result therefore of the inoculation of the culture into the goat is the exact converse of that following the inoculation into the calf. In the calf dysgonic virulent bacilli only were isolated from the distal lesions while the culture from the nearest gland was composed of virulent bacilli with a slight admixture of easy-growing bacilli. In the goat on the other hand apparently only eugonic slightly virulent bacilli were disseminated, the culture from a remote part (the mamma) being composed wholly of bacilli of this type, while in the gland nearest the local lesion the bacilli were mainly of the eugonic slightly virulent type, virulent tubercle bacilli being present in very small numbers, as shown by the results in rabbits of the inoculation of an emulsion of the gland.

The difference in the results obtained with the goat from those obtained with the calf was probably due to the fact that a glycerin serum and not a serum culture was used. Growth on glycerin serum had reduced the proportion of the virulent bacilli by favouring the multiplication of the more easy-growing slightly virulent bacilli.

SEPARATION EXPERIMENT ON GLYCERIN MEDIA.

(See Table Q.)

When the culture had been over 16 months in artificial cultivation on serum, it was sown on glycerin serum and subcultivated continuously on this media for four months. The culture was then tested on a series of rabbits (Nos. 2300-2302) all of which died of general tuberculosis. Cultivation on glycerin serum had not therefore eliminated the virulent bacilli in the culture.

SEPARATION BY PLATE CULTURES.

(See Table S.)

Culture from
Guinea-pig
3300.

A guinea-pig, No. 3300, was inoculated intraperitoneally with the retro-peritoneal gland strain and killed 21 days afterwards. Serum plates and egg tubes were sown with emulsions from a sternal gland and the pyloric gland; the serum plates became so closely covered with colonies that it was impossible to pick off single colonies. On the egg tubes however sown from the pyloric gland the colonies were in places sufficiently discrete, and three large colonies were taken and separately subcultivated. The three strains produced pigmented growths on serum and they were each tested on a series of rabbits intravenously and found to be slightly virulent.

Culture from
Rabbit 2019.

Separate colonies were also investigated from a rabbit which had been inoculated intravenously with the original culture at the same time as the guinea-pig. It died of acute tuberculosis in 20 days. Five colonies were taken from two egg tubes (which had been sown with an emulsion of the spleen) and separately cultivated; three were tested on rabbits, each strain being inoculated intravenously into two rabbits in doses of 0.1 and 0.01 milligramme; two of the strains produced rapidly fatal tuberculosis in all the animals inoculated and were equal in virulence to a bovine tubercle bacillus; one of the two rabbits inoculated with the third strain died in 17 days of coccidiosis of the liver and showed slight tuberculosis of the lungs, the other was killed after 104 days and showed disseminated tuberculosis of a type not unusual with viruses of low bovine virulence.

The two virulent strains grew poorly on glycerin media; the third strain was lost before it was tested on glycerin media, but it produced pigmented growths on serum.

From the original culture through the guinea-pig therefore three strains of culture have been isolated which are identical with the human tubercle bacillus, and from a rabbit inoculated with the original culture there have been isolated one strain with the properties of the human tubercle bacillus and two with the properties of the bovine tubercle bacillus.

SUMMARY.

From the culture derived from the retroperitoneal gland of Virus H 90, "I.P." bacilli with the properties of the human and the bovine tubercle bacillus respectively have been obtained by passage through the animal body and by means of the plate method of cultivation.

A. STANLEY GRIFFITH.

TABULAR SUMMARIES OF THE PRELIMINARY INOCULATION TESTS WITH VIRUSES H 2, H 13, H 16, H 17, AND H 49.

										PAGE
Virus H 2. "Sp. A."	{	Strain derived from Calf 93		}	24
		"	Calf 111							
Virus H 13. "A.D."	{	Strain derived from Calf 301		}	24
		"	Rat 15							
Virus H 16. "J.H."	{	Strain derived from Calf 275		}	2
		"	Bull 423A							
		"	Calf 559							
Virus H 17. "Sp. B."	{	Strain derived from Calf 265		}	26	
		"	Calf 539 (through Rabbit 181)							
		"	Calf 539 (through Rabbit 181 and Guinea pig 2017).							
Virus H 49. "T.C."	{	Strain derived from original material (Blythwood Strain		}	27		
		"	(Royalcot Strain)							
		Strain derived from Calf 797								
	{	"	Calf 787	}						

VIRUS H 2. "Sp. A."

Culture derived from Calf 93 through G.P. 534.

Total duration of artificial cultivation—3 years 8 months. The 30th generation of culture was used when 21 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1165 {	Intrav. Subcut.	1·0 1·0 }	1,700	1,200	Died 18 days	General tuberculosis.
1166	Intrav.	0·1	1,900	1,430	Died 27 "	General tuberculosis.
1167	Intrap.	10·0	1,750	1,250	Died 20 "	General tuberculosis.
1168	Intrap.	1·0	2,000	1,420	Died 33 "	General tuberculosis.
1169	Subcut.	10·0	1,700	1,590	Died 5 "	No tuberculosis. Death from heart disease.

Culture derived from Calf 111 through G.P. 640.

Total duration of artificial cultivation—3 years 3 months. The subculture was used when 21 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1061	Intrav.	1·0	1,100	1,250	Killed 111 days	Very slight tuberculosis of lungs and kidneys.
1062	Intrav.	0·1	950	2,100	" "	Slight tuberculosis of lungs and kidneys.
1063	Intrap.	10·0	1,100	2,400	" "	Slight general tuberculosis.
1064	Intrap.	1·0	850	1,750	" "	Very slight general tuberculosis.
1065	Subcut.	50·0	900	1,900	" "	Local lesion : one tubercle in lung.
1066	Subcut.	10·0	850	2,100	" "	Local tuberculosis only.
1067	Subcut.	1·0	950	2,250	" "	Local tuberculosis only.

VIRUS H 13. "A.D."

Culture derived from Calf 301. (Thoracic Gland.)

Total duration of artificial cultivation—3 years. The 28th generation of culture was used when 21 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1136	Intrav.	1·0	2,950	2,800	Died 18 days	General tuberculosis.
1137	Intrav.	0·1	2,370	1,700	Died 27 "	General tuberculosis.
1138	Intrap.	10·0	2,070	1,470	Died 12 "	Acute tuberculosis.
1139	Intrap.	1·0	1,490	1,100	Died 27 "	General tuberculosis.
1140	Subcut.	10·0	1,620	1,220	Died 52 "	General tuberculosis.
1141	Subcut.	10·0	1,000	850	Died 2 "	No tuberculosis.

The culture was again tested a year later to ascertain whether there had been any alteration in virulence.
The 39th generation of culture was used when 7 days old.

1712	Intrav.	1·0	1,450	1,200	Died 11 days	General tuberculosis.
1710	Intrav.	0·1	2,100	1,600	Died 25 "	General miliary tuberculosis.
1711	Intrav.	0·1	1,700	1,300	Died 29 "	Acute miliary tuberculosis.
1713	Subcut.	20·0	—	—		

Culture derived from Calf 301 through Rat 15.

Total duration of artificial cultivation—2 years 7½ months. The 25th generation of culture was used when 21 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1176	Intrav.	1·0	1,570	1,300	Died 15 days	General tuberculosis.
1177	Intrav.	0·1	800	750	Died 25 „	General tuberculosis.
1178	Intrap.	1·0	800	1,100	Died 101 „	General tuberculosis (injection partly intracoecal).
1179	Intrap.	0·1	600	900	Died 106 „	General tuberculosis (injection partly subcutaneous and probably partly intracoecal).

VIRUS H 16. "J.H."

Culture derived from Calf 273. (Prescapular Gland.)

Total duration of artificial cultivation—3 years. The 36th generation of culture was used when 21 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1106	Intrav.	1·0	1,350	2,300	Killed 94 days	Slight tuberculosis of lungs and kidneys.
1107	Intrav.	0·1	1,000	1,850	„ „	Very slight general tuberculosis.
1108	Intrap.	10·0	1,050	1,700	„ „	Very slight general tuberculosis.
1109	Intrap.	1·0	1,020	2,050	„ „	Tuberculosis of peritoneum and kidneys.
1110	Subcut.	30·0	1,100	2,350	„ „	Slight general tuberculosis.
1111	Subcut.	10·0	950	1,850	„ „	Local lesion and slight tuberculosis of lungs.

Culture derived from Bull 423A. (Prepectoral Gland.)

Total duration of artificial cultivation—2 years 6 months. The 29th generation of culture was used when 21 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1131	Intrav.	1·0	1,700	1,380	Died 17 days	General tuberculosis.
1132	Intrav.	0·1	1,200	1,050	Died 20 „	General tuberculosis.
1133	Intrap.	10·0	1,150	830	Died 17 „	General tuberculosis.
1134	Intrap.	1·0	1,250	900	Died 26 „	General tuberculosis.
1135	Subcut.	10·0	1,550	1,360	Died 126 „	General tuberculosis.

Culture derived from Calf 559. (Hepatic Gland.)

Total duration of artificial cultivation—2 years 1½ months. The 25th generation of culture was used when 21 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight		Duration of Life.	Result.
			Initial.	Final.		
1126	Intrav.	1·0	1,550	1,100	Died 20 days	General tuberculosis
1127	Intrav.	0·1	1,950	1,190	Died 109 „	Tuberculosis of lungs and kidneys (severe) and large intestines.
1128	Intrap.	10·0	3,050	1,720	Died 80 „	General tuberculosis (injection mainly intracoecal).
1129	Intrap.	1·0	1,850	1,510	Died 24 „	General tuberculosis.
1130	Subcut.	10·0	1,700	1,570	Died 119 „	General tuberculosis.

VIRUS H 17. "Sp. B."

Culture derived from Calf 265. (Prescapular Gland.)

Total duration of artificial cultivation—3 years. The 30th generation of culture was used when 21 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1100	Intrav.	1·0	900	1,750	Killed 97 days	Slight general tuberculosis.
1101	Intrav.	0·1	850	1,950	„ „	Slight general tuberculosis.
1102	Intrap.	10·0	700	1,150	„ „	Slight general tuberculosis.
1103	Intrap.	1·0	670	1,550	„ „	Slight general tuberculosis.
1104	Subcut.	50·0	540	1,450	„ „	Local tuberculosis and miliary tuberculosis of the lungs.
1105	Subcut.	10·0	670	1,900	„ „	Local tuberculosis and miliary tuberculosis of the lungs.

Culture derived from Calf 539, through Rabbit 181.

Total duration of artificial cultivation—2 years 2 months. The 27th generation of culture was used when 21 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1113	Intrav.	1·0	900	1,900	Killed 97 days	Tuberculosis of lungs and kidneys.
1112	Intrav.	0·1	900	2,020	„ „	Slight tuberculosis of lungs and kidneys.
1114	Intrap.	10·0	410	1,300	„ „	Chronic general tuberculosis.
1115	Intrap.	1·0	450	1,500	„ „	Local tuberculosis and slight tuberculosis of lungs.
1116	Succut.	47·5	430	1,750	„ „	Local tuberculosis and slight tuberculosis of lungs.
1117	Subcut.	10·0	410	1,600	„ „	Local tuberculosis and slight tuberculosis of lungs.

Culture derived from Calf 539 through Rabbit 181 and Guinea-pig 2017.

Total duration of artificial cultivation—53 days. The 4th generation of culture was used when 20 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1142	Intrav.	1·0	1,850	1,000	Killed 85 days	General tuberculosis complicated with pseudo-tuberculosis. Tuberculosis of lungs and kidneys.
1143	Intrav.	0·1	1,450	2,300	Killed 85 "	
1144	Intrap.	10·0	1,750	1,350	Died 11 "	Early tuberculosis of omentum: no sign of disease elsewhere. Slight general tuberculosis.
1145	Intrap.	1·0	1,070	2,300	Killed 85 "	

VIRUS H 49. "T.C."

Culture derived from the Mesenteric Glands, direct. Blythwood strain.

Total duration of artificial cultivation—1 year 8½ months. The 21st generation of culture was used when 22 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1048	Intrav.	1·0	1,100	2,600	Killed 130 days	Slight tuberculosis of lungs and kidneys.
1049	Intrav.	0·1	1,150	1,050	Died 11 "	Pseudo-tuberculosis.
1051	Intrap.	10·0	1,250	2,500	Killed 130 "	Slight tuberculosis of omentum and (?) of lungs.
1050	Intrap.	1·0	1,450	3,050	Killed 130 "	Slight tuberculosis of omentum, kidneys and lungs.
1052	Subcut.	10·0	1,150	2,700	Killed 130 "	Local lesion and slight tuberculosis of lungs.
1053	Subcut.	1·0	1,250	2,800	Killed 130 "	Local lesion only.

Culture derived from the Mesenteric Glands, direct. Royalcot strain.

Total duration of artificial cultivation—1 year 10½ months. The 25th generation of culture was used when 21 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1180	Intrav.	1·0	1,000	1,000	Died 16 days	General tuberculosis.
1181	Intrav.	0·1	1,100	920	Died 31 "	General miliary tuberculosis.
1182	Intrap.	1·0	750	2,050	Killed 163 "	Chronic general tuberculosis (injection intracoecal).

Culture derived from Calf 797. (Prescapular Gland.)

Total duration of artificial cultivation—1 year 4 months. The 13th generation of culture was used when 22 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1071	Intrav.	1·0	1,300	1,240	Died 13 days	General tuberculosis.
1072	Intrav.	0·1	1,450	1,470	Died 16 "	General tuberculosis.
1073	Intrap.	10·0	1,300	1,110	Died 12 "	Acute tuberculosis complicated by severe psorospermiosis.
1074	Intrap.	1·0	950	770	Died 13 "	General tuberculosis.
1075	Subcut.	10·0	900	1,060	Died 41 "	General tuberculosis.
1076	Subcut.	1·0	900	950	Died 80 "	General tuberculosis.

Culture derived from Calf 787.

Total duration of artificial cultivation—1 year 4 months. The 13th generation of culture was used when 21 days old.

Number of Rabbit.	Mode of Inoculation.	Dose in Milli-grammes.	Weight.		Duration of Life.	Result.
			Initial.	Final.		
1079	Intrav.	1·0	1,850	1,460	Died 17 days	General tuberculosis.
1080	Intrav.	0·1	1,800	1,790	Died 19 "	General tuberculosis.
1081	Intrap.	10·0	1,870	1,270	Died 14 "	General tuberculosis.
1082	Intrap.	1·0	1,720	1,470	Died 19 "	General tuberculosis.
1083	Subcut.	10·0	1,720	1,050	Died 71 "	General tuberculosis.
1084	Subcut.	1·0	1,600	1,800	Died 90 "	General tuberculosis.

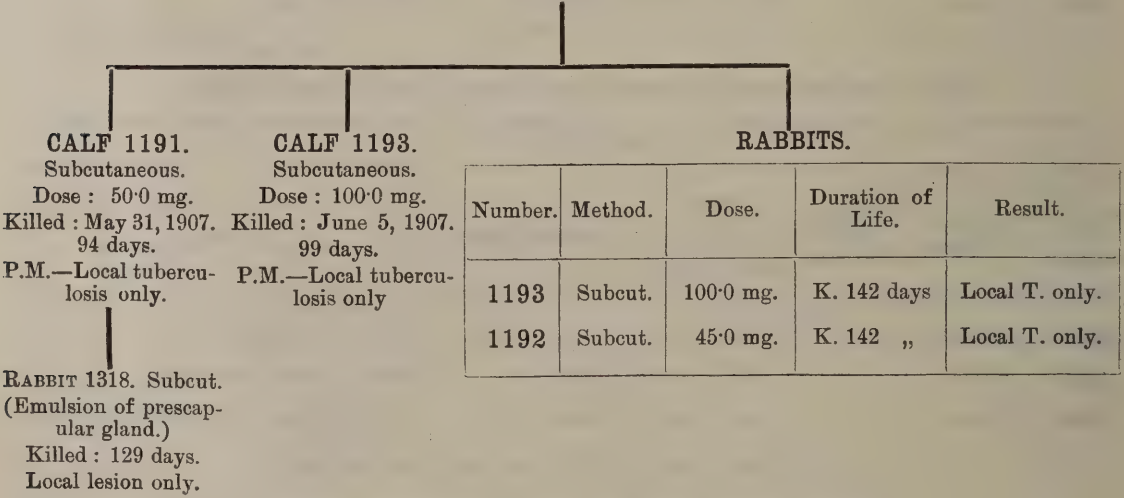
VIRUS H 49. "T.C."

CULTURE DERIVED FROM THE MESENTERIC GLANDS (BLYTHWOOD STRAIN).

CULTURE INOCULATIONS.

The strain was derived from the original material, and had been in cultivation a total period of 1 year 11 months.

The 25th generation of culture was used on Feb. 26, 1907, when 21 days old.



CHARTS OF SEPARATION EXPERIMENTS WITH VIRUSES

H 13. "A.D.," H 49. "T.C.," H 60. "W.B.," AND H 90. "I.P."

Virus H 13. "A.D." (Calf 301 Strain.)

Table A.—Separation by animal inoculation (Calf).

"	B.—	"	"	"	"	(Rabbit).
"	C.—	Separation by glycerin media.				
"	D.—	Investigation of separate colonies.				
"	E.—	"	"	"	"	
"	F.—	"	"	"	"	

Virus H 49. "T.C." (Original Strain).

Table G.—Rabbit inoculations with the original culture.

"	H.—	Separation by animal inoculation (Calf).				
"	I.—	Investigation of separate colonies.				
"	J.—	"	"	"	"	
"	K.—	"	"	"	"	

Virus H 60. "W.B." (Bronchial Gland Strain.)

Table L.—Separation by animal inoculation (Calf).

"	M.—	{ Separation by animal inoculation (Rabbit).				
		{ Investigation of a single colony on glycerin serum.				
"	N.—	Test of original culture after growth on glycerin media.				
"	O.—	Investigation of separate colonies.				

Virus H 90. "I.P." (Retroperitoneal Gland Strain.)

Table P.—Separation by animal inoculation (Calf).

"	Q.—	"	"	"	"	(Rabbit).
"	R.—	"	"	"	"	(Goat).
"	S.—	Investigation of separate colonies.				

TABLE A.
VIRUS H 13. "A.D."
CULTURE DERIVED FROM CALF 301 (THORACIC GLAND).
SEPARATION BY ANIMAL INOCULATION

CULTURE INOCULATION.
The strain had been 3 years 2 months in artificial cultivation; the 31st generation of culture was used on March 23, 1907, when 21 days old.

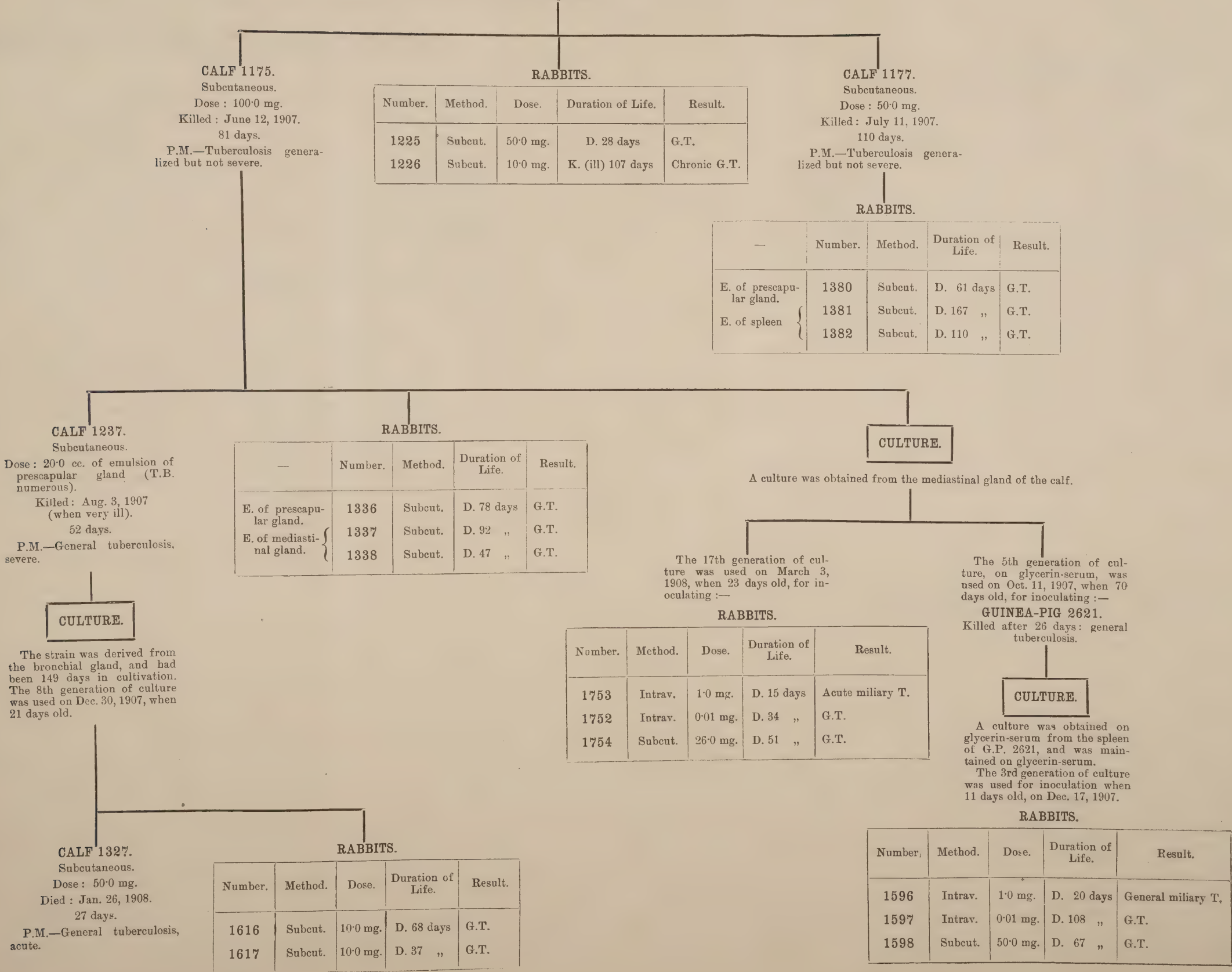


TABLE B.

VIRUS H 13. "A.D."

CULTURE DERIVED FROM CALF 301 (THORACIC GLAND).

SEPARATION BY ANIMAL INOCULATION.

I.

RABBIT 1137.

Inoculated intravenously on February 4, 1907, with 0.1 mg. of culture derived from Calf 301; the 29th generation of culture was used when 21 days old.

The Rabbit died in 27 days of general tuberculosis.

CULTURE.

A culture was raised from the spleen, on glycerin-serum. The 4th generation on glycerin-serum was used for inoculation on June 5, 1907, when 21 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1326	Intrav.	1.0 mg.	D. 10 days	Early T.
1327	Subcut.	40.0 mg.	D. 28 "	G.T.
1328	Subcut.	10.0 mg.	D. 4 "	No T.

CULTURE.

A culture was raised from the spleen, on serum.

The 11th generation on serum was used on October 2, 1907, when 14 days old.

RABBIT 1526.

Subcutaneous.

Dose: 1 serum tube.
Died: 62 days. G.T.

II.

RABBIT 1140.

Inoculated subcutaneously on February 4, 1907, with 10.0 mg. of culture derived from Calf 301; the 29th generation of culture was used when 21 days old.

The Rabbit died in 52 days of general tuberculosis.

CULTURE.

A culture was raised from the lung. The 9th generation on serum was used for inoculation on October 2, 1907, when 14 days old.

RABBIT 1527.

Subcutaneous.

Dose: 1 serum tube.
Died: 29 days. G.T.

TABLE C.

VIRUS H 13. "A.D."

CULTURE DERIVED FROM CALF 301 (THORACIC GLAND).

TESTED AFTER GROWTH ON GLYCERIN MEDIA.

The strain had been 3 years 2 months in artificial cultivation; the 33rd generation of culture was used on March 26, 1907, when 14 days old; the two previous generations had been on glycerin-serum.

CALF 1207.

Subcutaneous.

Dose: 100.0 mg.

Killed: June 26, 1907.

92 days.

P.M.—Tuberculosis generalized but not severe.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1236	Subcut.	50.0 mg.	D. 103 days	G.T. of a chronic type.
1237	Subcut.	10.0 mg.	D. 100 "	G.T. of a chronic type.

RABBITS.

	Number.	Method.	Duration of Life.	Result.
E. of prescapular gland.	1354	Subcut.	D. 92 days	G.T.
	1355	Subcut.	D. 9 "	No T.
E. of mediastinal gland.	1356	Subcut.	D. 5 "	No T.
	1357	Subcut.	D. 53 "	G.T.

TABLE D.

VIRUS H. 13. "A.D."

CULTURE DERIVED FROM CALF 301 (THORACIC GLAND).

INVESTIGATION OF SEPARATE COLONIES.

GUINEA-PIG 2491.

Inoculated on July 4, 1907, intraperitoneally with an emulsion of a large raised colony from an egg tube; [the culture was the 25th generation, 205 days old].

The guinea-pig was killed 25 days later, and cultures were sown from a caseous sternal gland.

CULTURES.

Ten single colonies from the glycerin-serum plates sown from the guinea pig were separately cultivated.

Growths from glycerin-serum tubes of the 2nd generation of each of the ten strains were inoculated into rabbits on September 30 and October 1, 1907.

RABBITS.

Number.	Method.	No. of Colony.	Dose.	Duration of Life.	Result.
1512	Subcut.	Col. 1	½ glyc. serum tube	K. 98 days	Slight G.T.
1513	Subcut.	"	Do. large dose	K. 106 "	G.T.
1514	Subcut.	Col. 2	½ glyc. serum tube ; large dose.	K. 98 "	Local T., and a few (?) tubercles in the lung.
1515	Subcut.	"	Do. do.	K. 106 "	Gen. progressive T.
1516	Subcut.	Col. 3	1 glyc. serum tube ; large dose.	K. 106 "	Local lesion. Slight T. of lungs and kidneys.
1517	Subcut.	Col. 4	Not so large as 1516.	D. 64 "	G.T.
1518	Subcut.	Col. 5	Not so large as 1517.	D. 36 "	G.T.
1519	Subcut.	Col. 6	1 glyc. serum tube ; large dose.	K. 106 "	Local lesion. T. of lungs. One tubercle in a kidney
1520	Subcut.	Col. 7	Do. do.	D. 46 "	G.T.
1521	Subcut.	Col. 8	1 glyc. serum tube ; dose smaller than others.	K. 106 "	Local lesion. T. of lungs. One tubercle in kidney.
1522	Subcut.	Col. 9	1 glyc. serum tube ; large dose.	K. 106 "	Local lesion. Slight T. of lungs and pleura.
1523	Subcut.	Col. 10	Do. do.	K. 106 "	G.T.

The culture raised from Colony 9 was retested on January 15, 1908, on a series of Rabbits with estimated doses. The 8th generation of culture was used when 27 days old.

1666	Intrav.	Col. 9	1.0 mg.	D. 80 days	G.T.
1665	Intrav.	"	0.1 mg.	D. 71 "	Severe G.T.
1667	Subcut.	"	68.0 mg.	D. 66 "	G.T. not severe.

COLONY No. 2.

Culture of the 6th generation from Colony No. 2, was used on November 12, 1907, when 10 days old, for inoculating :—

CALF 1301.
Subcutaneous.
Dose : 100.0 mg.
Died : Jan. 2, 1908
51 days.
P.M.—General tuberculosis, very severe in lungs.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1560	Intrav.	1.0 mg	D. 19 days	Acute G.T.
1559	Intrav.	0.01 mg.	D. 83 "	G.T.

COLONY No. 5.

Culture of the 6th generation from Colony No. 5, was used on November 12, 1907, when 10 days old, for inoculating :—

CALF 1309.

Subcutaneous.
Dose : 44.0 mg.
Died : Dec. 12, 1907.
30 days.
P.M.—Acute general tuberculosis.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1562	Intrav.	1.0 mg.	D. 16 days	Acute G.T.
1561	Intrav.	0.01 mg.	D. 42 "	G.T.

MAY 1, 1908.					
Culture derived from a lung tubercle from Rabbit 1516.	1842	Intrav.	0.1 mg.	D. 40 days	Slight T. of lungs and a kidney.
	1843	Intrav.	0.01 mg.	K. 152 "	Slight T. of lungs and a kidney. T. of one knee joint.
APRIL 24, 1908.					
Culture derived from a lung tubercle from Rabbit 1519.	1830	Intrav.	0.1 mg.	K. 137 days	T. of lungs, kidneys, and mamma, not apparently progressive.
	1831	Intrav.	0.01 mg.	K. 137 "	Slight T. of lungs and kidneys.
APRIL 24, 1908.					
Culture derived from a lung tubercle from Rabbit 1521.	1832	Intrav.	0.1 mg.	D. 134 days	Chronic G.T. (no evidence of presence of bacilli of Group I.).
	1833	Intrav.	0.01 mg.	D. 3 "	No T.

CULTURE DERIVED FROM CALF 301 (THORACIC GLAND).

INVESTIGATION OF SEPARATE COLONIES.

RABBIT 1506.
Subcutaneous.
Killed after 92 days.
Severe general tuberculosis.

GUINEA-PIG 2605.
Intraperitoneal.
Killed : Oct. 14, 1907.
25 days.
General tuberculosis.

Experiments with cultures raised in ordinary way.

Experiments with cultures raised from single colonies.

RABBIT 1538.
Intravenous.
Emulsion of omentum of
Guinea-pig 2605.
Died : 28 days.
General miliary tuberculosis

CULTURE.

CULTURE.

CULTURE.

CULTURE.

The strain was derived from the spleen of the guinea-pig, and had been raised and maintained on glycerin-serum. The 4th generation of culture was used, on Dec. 9, 1907, when 8 days old.

The strain was derived from the omentum of the guinea-pig, and had been raised and maintained on glycerin-serum. The 5th generation of culture was used, on Dec. 17, 1907, when 9 days old.

A single colony was isolated from a serum-agar plate sown from the omentum of the guinea-pig, and subcultivated on serum. The 7th generation of culture was used, on March 17, 1908, when 21 days old.

Animals inoculated on Jan. 16 and 17, 1908, with cultures derived from separate colonies taken from a glycerin-serum plate sown from the omentum of the guinea-pig.

RABBITS.

GUINEA-PIG 2839.
Subcutaneous.
Dose: 1.0 mg.
Died: 19 days.
Early G.T.

CULTURE.

The strain was derived from the inguinal gland. The 6th generation of culture was used, on April 9, 1908, when 24 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1586	Intrav.	1.0 mg.	D. 25 days	General mili- ary T.
1587	Intrav.	0.1 mg.	D. 38 "	G.T.
1588	Intrav.	0.01 mg.	D. 87 "	G.T.
1589	Subcut.	50.0 mg.	D. 115 "	G.T. and pseudo-tu- berculosis.

Number.	Method.	Dose.	Duration of Life.	Result.
1820	Intrav.	1.0 mg.	D. 21 days	General mili- ary T.
1821	Subcut.	122.0 mg.	D. 117 "	G.T.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1599	Intrav.	1·0 mg.	D. 24 days	General mili- ary T.
1600	Intrav.	0·1 mg.	D. 27 "	G.T.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1778	Intrav.	1.0 mg.	D. 32 days	G.T.
1779	Intrav.	0.01 mg.	K. 192 "	Slight T. of lungs and kidneys.
1777	Subcut.	84.0 mg.	D. 124 "	Local lesion and slight T. of lungs and kidneys Death from an acute infection.

RABBITS.

Number.	Method.	No. of Colony.	Dose.	Duration of Life.	Result.
1676	Intrav.	Col. 4	0.1 mg.	D. 18 days	G.T.
1675	"	"	0.01 mg.	D. 28 "	G.T.
1672	Intrav.	Col. 6	1.0 mg.	D. 69 "	T. of lungs and kidneys.
1671	"	"	0.1 mg.	K. 119 "	Slight T. of lungs and kidneys.
1678	Intrav.	Col. 7	1.0 mg.	D. 104 "	T. of lungs and kidneys.
1679	"	"	0.01 mg.	K. 119 "	Slight T. of lungs and a kidney.
1673	Intrav.	Col. 8	0.1 mg.	D. 106 "	General progressive T.
1674	"	"	0.01 mg.	K. 119 "	G.T. not severe ; apparently progressive.
1680	Intrav.	Col. 9	1.0 mg.	K. 119 "	T. of lungs and kidneys.
1679	"	"	0.01 mg.	K. 119 "	T. of lungs only.
1682	Intrav.	Col. 10	1.0 mg.	D. 17 "	G.T.
1681	"	"	0.01 mg. (+0.02mg. subcut.).	D. 46 "	G.T.

CALF 1343.

Subcutaneous.
Culture from Colony 6.
Dose : 78.0 mg.
Killed : April 9, 1908.
84 days.
P.M.—Local tuberculosis : one tubercle in lung and a minute focus in a bronchial gland.

CALF 1337.

Subcutaneous.
Culture from Colony 7.
Dose : 59.0 mg.
Killed : April 2, 1908.
76 days.
P.M.—Local tuberculosis : one minute focus in a bronchial gland.

TABLE F.

VIRUS H 13. "A.D."

CULTURE DERIVED FROM CALF 301 (THORACIC GLAND).

INVESTIGATION OF SEPARATE COLONIES.

GUINEA-PIG 2621.

Inoculated on October 11, 1907, with culture from the mediastinal gland of Calf 1175 (inoculated with 100.0 mg. of culture from Calf 301). The culture used was the 5th generation, 70 days old, on glycerin serum.

The guinea-pig was killed after 26 days, and showed general tuberculosis.

CULTURE.

Ten single colonies were removed from an egg tube sown from the prescapular gland of Calf 1175 (inoculated with 100.0 mg. of culture from Calf 301).

The growth from one serum tube of the 3rd generation of each of the ten strains was inoculated into a Rabbit on August 21, 1907.

RABBITS.

Number.	Method.	No. of Colony.	Dose.	Duration of Life.	Result.
1461	Subcut.	Col. 1	1 serum tube	D. 16 days	Local T. Cysticercosis.
1462	Subcut.	Col. 2	"	D. 5 "	No T. Cause of death not determined.
1463	Subcut.	Col. 3	"	D. 16 "	Local T. Cause of death not determined.
1464	Subcut.	Col. 4	"	D. 55 "	G.T.
1465	Subcut.	Col. 5	"	D. 81 "	G.T.
1466	Subcut.	Col. 6	"	K. 110 "	Chronic G.T.
1467	Subcut.	Col. 7	"	D. 3 "	Slight pseudo-tuberculosis ; ? cause of death.
1468	Subcut.	Col. 8	"	D. 67 "	G.T.
1469	Subcut.	Col. 9	"	K. 110 "	Chronic G.T., apparently retrogressive.
1470	Subcut.	Col. 10	"	D. 49 "	G.T.

CULTURES.

Six colonies were isolated from glycerin-serum tubes sown from the guinea-pig, separately cultivated on serum, and inoculated into Rabbits.

RABBITS.

Date.	Number.	Method.	No. of Colony.	Age and Generation.	Dose.	Duration of Life.	Result.
March 30, 1908.	1787	Intrav.	Col. 1	5th gen., 14 days old	0.1 mg.	D. 51 days	G.T.
	1788	Intrav.	"	" "	0.01 mg.	D. 98 "	G.T.
	1789	Intrav.	Col. 2	5th gen., 14 days old	0.1 mg.	D. 161 "	G.T. (progressive in thorax).
	1790	Intrav.	"	" "	0.01 mg.	K. 162 "	T. of mammary glands and slight T. of lungs.
	1791	Subcut.	Col. 3	5th gen., 14 days old	Culture had agglutinated and was not estimated.	D. 56 "	Slight G.T.
	1792	Subcut.	Col. 4	5th gen., 14 days old	Growth from 2 serum tubes.	D. 41 "	Local T., T. of lungs, and three nodules in the kidneys.
May 11, 1908.	1849	Subcut.	Col. 5	4th gen., 20 days old	Growth from 1½ serum tubes.	D. 65 "	G.T.
	1850	Subcut.	Col. 6	4th gen., 20 days old	Growth from 1½ serum tubes.	D. 66 "	G.T.

A culture was obtained in the ordinary way from a glycerin-serum tube sown from the spleen of the guinea-pig, maintained on glycerin-serum for 162 days, and then inoculated into Rabbits.

The 6th generation of culture, 17 days old, was used.

RABBITS.

Number.	Method.	Dose.	Duration Life.	Result.
1827	Subcut.	Growth from one G.S. tube.	D. 105 days	Slight G.T.
1828	Subcut.	Do. (larger)	D. 109 "	G.T.

TABLE G.

VIRUS H 49. "T.C."

CULTURE DERIVED FROM THE MESENTERIC GLANDS (ROYALCOT STRAIN).

CULTURE INOCULATIONS.

(a) PRELIMINARY TEST.

The strain was derived from the original material, and had been in cultivation a total period of 1 year 10½ months,

The 25th generation of culture was used on Feb. 19, 1907, when 21 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1180	Intrav.	1.0 mg.	D. 16 days	G.T.
1181	Intrav.	0.1 mg.	D. 31 "	General military T.
1182	Intrap.	1.0 mg.	K. 163 "	Chronic G.T. (Injection intra-coecal.)

RABBITS inoculated with emulsion of lung from Rabbit 1181.

Number.	Method.	Duration of Life.	Result.
1219	Subcut.	D. 74 days	G.T.
1220	Subcut.	D. 82 "	G.T.

(b) REPEAT TEST.

The strain had been in artificial cultivation a total period of 2 years 11 months.

The 36th generation of culture was used on Jan. 30, 1908, when 7 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1708	Intrav.	1.0 mg.	D. 19 days	G.T.
1706	Intrav.	0.1 mg.	D. 31 "	Severe G.T.
1707	Intrav.	0.1 mg.	D. 24 "	G.T.
1709	Subcut.	20.0 mg.	D. 117 "	G.T.

TABLE H.
VIRUS H 49. "T.C."
CULTURE DERIVED FROM THE MESENTERIC GLANDS (ROYALCOT STRAIN)
SEPARATION BY ANIMAL INOCULATION.

CULTURE.

The strain was derived from the original material, and had been in artificial cultivation a total period of 2 years 2 weeks.
The 29th generation of culture was used on April 20, 1907, when 25 days old.

CALF 1213.

Subcutaneous.

Dose : 50.0 mg.

Killed when in moderate health

July 9, 1907.

80 days.

P.M. — General progressive tuberculosis of a chronic type.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1264	Intrav.	1.0 mg.	D. 19 days	G.T.
1265	Intrav.	0.1 mg.	D. 30 "	G.T.
1266	Subcut.	47.0 mg.	K. (ill) 54 days	G.T.
1267	Subcut.	10.0 mg.	D. 104 days	G.T.

CALF 1263.

Subcutaneous.

Dose : 10.0 cc. of emulsion of prescapular gland (T.B. fairly numerous).

Killed : Oct. 8, 1907.

91 days.

P.M.—Chronic general tuberculosis, not severe.

RABBITS.

—	Number.	Method.	Dose.	Duration of Life.	Result.
E. of prescapular gland.	1378	Subcut.	4.0 cc.	D. 52 days	G.T.
	1379	Subcut.	4.0 cc.	K. 78 "	G.T.
E. of mediastinal gland.	1376	Subcut.	—	D. 122 "	G.T.
	1377	Subcut.	—	D. 86 "	G.T.

CULTURE.

The strain was derived from the mediastinal gland, and had been in artificial cultivation a total period of 83 days. The 6th generation of culture was used on Dec. 30, 1907, when 21 days old.

RABBITS.

—	Number.	Method.	Duration of Life.	Result.
E. of prescapular gland.	1536	Subcut.	D. 232 days	Chronic progressive tuberculosis.
E. of portal gland.	1537	Subcut.	D. 2 "	No T. (?) cause of death.

CALF 1347.

Subcutaneous.

Dose : 50.0 mg.

Killed when ill : Feb. 20, 1908.

52 days.

P.M. — General tuberculosis, severe.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1618	Subcut.	10.0 mg.	D. 74 days	G.T.
1619	Subcut.	7.3 mg.	D. 78 "	G.T.

TABLE I.

VIRUS H 49. "T.C."

CULTURE DERIVED FROM THE MESENTERIC GLANDS (ROYALCOT STRAIN).

INVESTIGATION OF SEPARATE COLONIES.

CALF 1213.

Inoculated subcutaneously with
50.0 mg. of culture derived from
the mesenteric glands.

Killed, July 9, 1907 (80 days).

CULTURE.

Twelve single colonies were isolated from an egg tube sown from the
prescapular gland of Calf 1213, and separately subcultivated. The
growth from one serum tube of the 3rd generation of each of the
12 strains was inoculated into a Rabbit, on August 23, 1907.

RABBITS.

Number.	Method.	No. of Colony.	Duration of Life.	Result.
1481	Subcut.	Col. 1	K. 108 days	Gen. progressive T., severe in lungs.
1482	Subcut.	Col. 2	D. 36 "	G. miliary T.
1483	Subcut.	Col. 3	D. 38 "	G.T.
1484	Subcut.	Col. 4	D. 35 "	G.T.
1485	Subcut.	Col. 5	D. 38 "	G.T.
1486	Subcut.	Col. 6	D. 72 "	G.T.
1487	Subcut.	Col. 7	D. 91 "	G.T.
1488	Subcut.	Col. 8	D. 82 "	G.T.
1489	Subcut.	Col. 9	K. 108 "	Gen. progressive T., not very severe.
1490	Subcut.	Col. 10	K. 108 "	Gen. progressive T., not very severe.
1491	Subcut.	Col. 11	D. 25 "	G.T.
1492	Subcut.	Col. 12	D. 23 "	Gen. miliary T.

TABLE J.

VIRUS H 49. "T.C."

CULTURE DERIVED FROM THE MESENTERIC GLANDS (ROYALCOT STRAIN).

INVESTIGATION OF SEPARATE COLONIES.

GUINEA-PIG 2490.

Inoculated intraperitoneally on July 4, 1907, with the growth from a glycerin-agar culture, 56 days old, the 11th generation from the original material.

The guinea-pig was killed 25 days later and showed general tuberculosis.

CULTURES.

Eleven colonies were removed from a glycerin-serum plate sown from the sternal gland of Guinea-pig 2490, and separately cultivated.

RABBITS inoculated with Cultures derived from these Colonies.

Date of Inoculation.	No. of Colony.	Age and Generation.	Number of Rabbit.	Method.	Dose.	Duration of Life.	Result.
October 15, 1907.	Col. 1	Each received one glycerin-serum culture, 2nd generation, 26 days old.	1539	Subcut.	Large	K. 98 days	Local lesion and slight T. of lungs.
	Col. 2		1540	Subcut.	Large	K. 98 "	Local T. Miliary tubercles in lungs. One tubercle in kidney.
	Col. 3		1541	Subcut.	Large	K. 94 "	Local lesion. Slight T. of lungs and kidneys.
	Col. 4		1542	Subcut.	Small	K. 99 "	Local lesion. Slight T. of lungs.
	Col. 5		1543	Subcut.	Small	K. 99 "	Local lesion. ? one or two tubercles in lungs.
	Col. 6		1544	Subcut.	Small	K. 99 "	Local T. and slight T. of lungs.
January 14, 1908.	Col. 7	6th gen., 27 days old.	1663	Subcut.	2 serum cultures.	K. 106 "	Local T. and T. of lungs.
January 11, 1908.	Col. 8	6th gen., 24 days old, on serum.	1648	Intrav.	1.0 mg.	K. 109 "	Fairly extensive miliary T. of lungs and kidneys.
			1647	Intrav.	0.1 mg.	K. 109 "	Slight T. of lungs and kidneys.
	Col. 9	6th gen., 24 days old, on serum.	1650	Intrav.	1.0 mg.	K. 109 "	Miliary T. of lungs and kidneys (not severe).
			1649	Intrav.	0.1 mg.	K. 109 "	Slight T. of lungs and kidneys.
January 14, 1908.	Col. 11	7th gen., 14 days old.	1664	Subcut.	2 serum cultures.	K. 106 "	Local T. and slight T. of lungs.

Cultures raised from Colonies 1, 2, and 3, were retested.

January 27, 1908.	Col. 1	6th gen., 5 days old.	1700	Intrav.	1.0 mg.	D. 21 days	Minute tubercles in lungs and kidneys. T.B. in spleen.
			1699	Intrav.	0.1 mg.	K. 110 "	T. of lungs (severe) and kidneys.
	Col. 2	7th gen., 5 days old.	1702	Intrav.	1.0 mg.	K. 110 "	T. of lungs, kidneys, portal gland, and mamma.
			1701	Intrav.	0.1 mg.	K. 110 "	T. of lungs, kidneys, and mamma.
	Col. 3	7th gen., 5 days old.	1704	Intrav.	1.0 mg.	K. 110 "	T. of lungs, kidneys, and mamma.
			1703	Intrav.	0.1 mg.	K. 110 "	

A culture was raised on serum from the sternal gland of the guinea-pig. To control the results obtained with separate colonies, a series of rabbits was inoculated on February 19, 1908, with this culture (4th generation, 12 days old, on serum).

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1737	Intrav.	1.0 mg.	D. 98 days	T. of lungs and kidneys.
1735	Intrav.	0.1 mg.	K. 114 "	Slight T. of lungs and kidneys.
1736	Intrav.	0.1 mg.	K. 114 "	
1738	Subcut.	50.0 mg.	D. 84 "	Local T., and T. of lungs (rather severe).

COLONY 9.

Culture of the 4th generation from Colony No. 9, on potato, was used when 40 days old for inoculating :

GUINEA-PIG 2816.

Intraperitoneal.

Killed 16 days later, and showed early general tuberculosis.

CULTURE.

A culture from the spleen was isolated and maintained on glycerin-serum.

Rabbits were inoculated on January 15, 1908, with cultures of the 3rd generation, 9 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1669	Intrav.	1.0 mg.	D. 79 days	T. of lungs and kidneys.
1668	Intrav.	0.1 mg.	K. 120 "	A few tubercles in the lungs. Local lesion and slight T. of lungs.
1670	Subcut.	19.0 mg.	K. 120 "	

CULTURE.

A culture was raised from the scapular gland of Rabbit 1544.

The 3rd generation, 13 days old, was used for inoculation on March 13 1908.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1762	Intrav.	1.0 mg.	D. 17 days	G.T.
1763	Intrav.	0.01 mg.	K. 91 "	Slight T. of lungs only.

CULTURE DERIVED FROM THE MESENTERIC GLANDS (ROYALCOT STRAIN).

GUINEA-PIG 2918.

The guinea-pig died 14 days later, and showed acute general tuberculosis.

Single colonies were removed from glycerin-serum media sown from the sternal gland, and sub-cultivated on serum.

November 12, 1908.

CALF 1501.

Subcutaneous.

Culture derived from
Colony 17.

Dose : 48.0 mg.

Died : Dec. 27, 190

45 days.

P.M.—General tuberculosis.

Small local tumour, partly cystic, partly fibro-calcareous. Prescapular gland dense caseous and gritty throughout. Lungs showed not very numerous fibro-calcareous nodules up to a hempeed. There were scattered calcareous tubercles in spleen, eight in liver. The thoracic glands were beset with calcareous tubercles, and several other lymph glands each contained one or more

The left prescapular gland was dense and caseous; one prepectoral gland contained a fibro-calcareous nodule.

Date.	Number of Colony.	Age and Generation of Culture.	Number.	Method.	Dose.	Duration of Life.	Result.
May 13, 1908	Colony 3	5th gen., 7 days old.	{ 1851 1852 1853	Intrav. Intrav. Intrav.	0.1 mg. 0.1 mg. 0.01 mg.	D. 27 days D. 25 " D. 27 "	Gen. miliary T. G.T. Gen. miliary T.
Aug. 5, 1908	Colony 5	8th gen., 18 days old.	{ 1960 1961 1962	Intrav. Intrav. Intrav.	1.0 mg. 0.1 mg. 0.01 mg.	K. 118 days K. 118 " K. 118 "	Slight T. of lungs and kidneys. Slight T. of lungs, kidneys, and one mamma. Slight T. of lungs and kidneys.
May 18, 1908	Colony 7	5th gen., 12 days old.	{ 1863 1864 1865	Intrav. Intrav. Intrav.	0.1 mg. 0.01 mg. 0.01 mg.	K. 152 days K. 152 " K. 102 "	Very slight T. of lungs and kid- neys. T. of lungs and one knee joint. Slight T. of lungs.
May 13, 1908	Colony 13	5th gen., 7 days old.	{ 1854 1855 1856	Intrav. Intrav. Intrav.	0.1 mg. 0.1 mg. 0.01 mg.	D. 22 days D. 22 " D. 76 "	Gen. miliary T. Gen. miliary T. G.T.
May 18, 1908	Colony 17	6th gen., 7 days old.	{ 1860 1861 1862	Intrav. Intrav. Intrav.	0.1 mg. 0.01 mg. 0.01 mg.	D. 15 days D. 25 " D. 28 "	G.T. G.T. Gen. miliary T.

TABLE L.
VIRUS H 60. "W.B."
CULTURE DERIVED FROM THE BRONCHIAL GLANDS.
Separation by Animal Inoculation.

(a) JUNE 15, 1906.

The strain was derived from the bronchial glands through Guinea-pig 1825, and had been in cultivation a total period of 72 days.

The culture used was the 3rd generation, 21 days old.

CALF 1099. Subcutaneous. Dose : 50·0 mg. Killed when dying : July 13, 1906. 28 days. P.M.—General tuber- culosis, severe.	RABBITS.				
	Number.	Method.	Dose.	Duration of Life.	Result.
	907	Intrap.	10·0 mg.	K.D. 28 days	G.T.
	908	Intrap.	1·0 mg.	D. 33 „	G.T.
	909	Intrap.	0·1 mg.	D. 83 „	Chronic progressive T. Injection probably subcut. to a slight extent.

(b) AUGUST 3, 1906.

Total duration of artificial cultivation : 121 days.

The culture used was the 4th generation, 23 days old.

CALF 1107. Subcutaneous. Dose : 10·0 mg. Died : Sept. 30, 1906. 58 days. P.M.—General tuber- culosis, severe.	CALF 1109. Subcutaneous. Dose : 10·0 mg. Died : Sept. 4, 1906. 32 days. P.M.—General tuber- culosis, severe.	RABBITS.				
		Number.	Method.	Dose.	Duration of Life.	Result.
		933	Intrap.	1·0 mg.	D. 36 days	G.T.
		934	Intrap.	0·1 mg.	K. (ill) 118 days	Chronic G.T.
		935	Intrap.	0·1 mg.	D. 82 days	G.T.
		936	Intrap.	0·01 mg.	D. 96 „	G.T.

TABLE M.

VIRUS H 60. W.B.

CULTURE DERIVED FROM THE HUMAN BRONCHIAL GLAND THROUGH GUINEA-PIG 1825.

SEPARATION BY ANIMAL INOCULATION.

RABBIT 935.
Intraperitoneal.
August 3, 1906.
Dose : 0·1 mg. of culture derived from Guinea-pig 1825.
Died : 82 days. G.T.

CULTURE.

A single colony from a glycerin-serum tube sown from Rabbit 935 was emulsified and inoculated on Nov. 23, 1906, when 31 days old, into :

RABBIT 1017.
Intraperitoneal.
Died : 32 days. G.T.

CULTURE.

A single colony from a glycerin-serum tube sown from Rabbit 1017 was emulsified and inoculated on Jan. 29, 1907, when 35 days old, into :

RABBIT 1121.
Subcutaneous.
Died : 112 days. G.T.

INVESTIGATION OF A SINGLE COLONY ON GLYCERIN-SERUM.

The first 3 generations of culture were on serum ; the fourth was sparsely sown on glycerin-serum. One of the four or five colonies which appeared was removed, cultivated on glycerin-agar, and then on serum. The serum culture was used for inoculation on Sept. 26, 1906, when 21 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
949	Intrap.	1·0 mg.	D. 31 days	G.T.
950	Intrap.	1·0 mg.	K. 103 "	G.T. Injection probably partly intracaecal.

CULTURE.

A single colony from a glycerin-serum tube sown from Rabbit 949 was emulsified and inoculated on Nov. 23, 1906, when 27 days old, into :

RABBIT 1018.
Intraperitoneal.

Died : 30 days. Acute military T.

CULTURE.

A single colony from a glycerin-serum tube sown from Rabbit 1018 was emulsified and inoculated on Jan. 29, 1907, when 36 days old, into .

RABBIT 1120.
Subcutaneous.
Died : 246 days. Chronic G.T.

CONTROL EXPERIMENT.

The 6th generation of culture on serum was used for inoculation on Sept. 26, 1906, when 21 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
951	Intrap.	1·0 mg.	K. 103 days	G.T. Injection partly intra caecal.
952	Intrap.	1·0 mg.	D. 35 "	G.T.

TABLE N.

VIRUS H 60. "W.B."

CULTURE DERIVED FROM THE HUMAN BRONCHIAL GLAND THROUGH GUINEA-PIG 1925.

TESTED AFTER GROWTH ON GLYCERIN MEDIA.

CULTURE INOCULATIONS.

(a).

The strain had been 310 days in artificial cultivation; the 10th generation, on glycerin-serum, was used on February 8, 1907, when 20 days old (the 5th generation was on glycerin agar, the others were on serum.)

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1163	Intrap.	Growth from $\frac{1}{2}$ culture tube each.	D. 128 days.	G.T.
1164	"		D. 109 "	G.T.

(b).

The strain had been 356 days in artificial cultivation; the 14th generation, on serum, was used on March 26, 1907, when 14 days old (the 5th and 10th generations were on glycerin agar)

CALF 1203.

Subcutaneous.

Dose : 48.0 mg.

Killed : July 1, 1907.

97 days.

P.M.—Cystic tumour. Caseo-calcareous nodules in prescapular gland. In the lungs there were small scattered grey tubercles, the larger with calcareous centres, and in the spleen similar but rather larger tubercles. The thoracic glands showed fairly numerous calcareous tubercles; one or more were seen in several other glands.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1228	Intrav.	1.0 mg.	D. 24 days	G.T.
1229	Intrav.	0.1 mg.	D. 37 "	G.T.
1230	Intrap.	1.0 mg.	D. 22 "	G.T.
1231	Subcut.	1.0 mg.	D. 170 "	G.T.

RABBITS.

—	No.	Method.	Duration of Life.	Result.
E. of bronchial gland.	1363	Subcut.	D. 111 days	G.T.
E. of prescapular gland.	1364	Subcut.	D. 1 day	No T.
	1365	Subcut.	D. 138 days	Chronic G.T.

CULTURES FROM CALF 1203.

Twelve single colonies from an egg tube sown from the prescapular gland of Calf 1203 were separately cultivated on serum.

The growth from one serum tube of the 3rd generation of each of the 12 strains was inoculated into a Rabbit on Aug. 20, 1907.

RABBITS.

Number.	Method.	Number of Colony.	Duration of Life.	Result.
1449	Subcut.	Col. 1	K. 120 days	Chronic G.T.
1450	Subcut.	Col. 2	K. 120 "	Chronic G.T.
1451	Subcut.	Col. 3	D. 88 "	G.T.
1452	Subcut.	Col. 4	D. 111 "	G.T.
1453	Subcut.	Col. 5	D. 72 "	G.T.
1454	Subcut.	Col. 6	D. 15 "	Death from pneumonia.
1455	Subcut.	Col. 7	K. 120 "	Chronic G.T.
1456	Subcut.	Col. 8	D. 110 "	G.T.
1457	Subcut.	Col. 9	K. 120 "	Chronic G.T.
1458	Subcut.	Col. 10	D. 97 "	G.T.
1459	Subcut.	Col. 11	D. 61 "	G.T.
1460	Subcut.	Col. 12	D. 83 "	G.T.

CULTURE.

TABLE O.

VIRUS H 60: "W.B."

CULTURE DERIVED FROM THE HUMAN BRONCHIAL GLAND THROUGH GUINEA-PIG 1825.
INVESTIGATION OF SEPARATE COLONIES.

Ten single colonies isolated from a glycerin-serum plate sown with an emulsion of a subculture (19th generation) of the original culture were separately cultivated on serum.

The growth from one serum tube of the 2nd generation of each of the 10 strains was inoculated into a Rabbit, on Aug. 9, 1907.

RABBITS.

Number.	Method.	Number of Colony.	Duration of Life.	Result.
1417	Subcut.	Col. 1	D. 106 days	G.T.
1418	Subcut.	Col. 2	D. 99 "	G.T.
1419	Subcut.	Col. 3	K. 119 "	Slight retrogressive G.T.
1420	Subcut.	Col. 4	K. 120 "	Chronic G.T., apparently progressive.
1421	Subcut.	Col. 5	D. 7 "	No apparent cause of death.
1422	Subcut.	Col. 6	D. 3 "	Coccidiosis of liver.
1423	Subcut.	Col. 7	D. 115 "	G.T.
1424	Subcut.	Col. 8	D. 9 "	Coccidiosis of liver.
1425	Subcut.	Col. 9	K. 120 "	Chronic G.T., probably progressive.
1426	Subcut.	Col. 10	D. 103 "	G.T.

GUINEA-PIG 2489.

Inoculated intraperitoneally on July 4, 1907, with a serum culture of the 17th generation from Guinea-pig 1825. The guinea-pig was killed 16 days later and showed early general tuberculosis.

CULTURES.

Six single colonies isolated from a glycerin-serum plate sown from Guinea-pig 2489 were separately cultivated.

The growth from one glycerin-serum culture of the 2nd generation of each of the 6 strains was inoculated into a rabbit, on Oct. 8, 1907.

RABBITS.

Number.	Method.	Number of Colony.	Dose.	Duration of Life.	Result.
1530	Subcut.	Col. 1	Large dose	K. 99 days	Local lesion. Slight T. of lungs.
1531	Subcut.	Col. 2	Medium "	D. 11 "	Local lesion. (?) cause of death.
1532	Subcut.	Col. 3	Medium "	K. 99 "	Local lesion only.
1535	Subcut.	Col. 4	Large "	D. 96 "	G.T.
1534	Subcut.	Col. 5	Large "	D. 53 "	G.T.
1533	Subcut.	Col. 6	Small "	K. 99 "	Chronic G.T.

The cultures raised from Colonies 1, 2, and 5 were re-tested on Dec. 19, 1907, with estimated doses. The 16th generation of culture on serum was used in each case, when 27 days old.

1601	Intrav.	Col. 1	0.1 mg.	K. 128 days	T. of lungs, and kidneys (slight).
1602	Intrav.	"	0.01 mg.	K. 128 "	Slight T. of lungs.
1603	Intrav.	Col. 2	0.1 mg.	K. 128 "	Slight T. of lungs and kidneys.
1604	Intrav.	"	0.01 mg.	K. 128 "	One tubercle in the right kidney only.
1605	Intrav.	Col. 5	1.0 mg.	D. 42 "	G.T.
1606	Intrav.	"	0.01 mg.	D. 67 "	G.T.

GUINEA-PIG 2817.

Inoculated intraperitoneally on Dec. 2, 1907, with a culture on potato of the 5th generation from Colony No. 1. The guinea-pig was killed 14 days later, and showed early general tuberculosis.

CULTURE.

A culture was obtained from the spleen of the guinea-pig. It was isolated and maintained on glycerin-serum. The 3rd generation was used when 7 days old.

RABBITS

Number.	Method.	Dose.	Duration of Life.	Result.
1656	Intrav.	1.0 mg.	D. 73 days	Scattered miliary tubercles in lungs. Death from intestinal obstruction.
1657	Intrav.	0.01 mg.	K. 121 "	Slight T. of lungs only.
1658	Subcut.	60.0 mg.	K. 121 "	Local lesion and slight T. of lungs.

JULY 30, 1908.

Inoculations with a serum culture derived from Colony 1.

CALF 1481.

Subcutaneous.
Dose : 50.0 mg.
Killed : Nov. 3, 1908.
96 days.
P.M. — Fibro - caseous and softened local tumour; fibro-caseo-calcareous nodules in left prescapular gland : seven grey tubercles in lungs, and a few calcareous grains in one ileo-colic gland.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1946	Subcut.	7.7 mg.	K. 161 days	Local lesion and slight T. of lungs.
1947	Subcut.	10.0 mg.	K. 161 "	Local lesion and slight T. of lungs and kidneys.

JULY 30, 1908.

Inoculations with a serum culture derived from Colony 5.

CALF 1425.

Subcutaneous.
Dose : 50.0 mg.
Killed when dying : Sept. 14, 1908.
46 days.
P.M.—General tuberculosis.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1949	Subcut.	1.0 mg.	D. 155 days	Chronic G.T.
1948	Subcut.	1.0 mg.	D. 49 "	G.T. not severe.

TABLE P.

VIRUS H 90. "I.P."

CULTURE DERIVED FROM THE RETROPERITONEAL GLAND.

Separation by Animal Inoculation (Calves).

CULTURE.

Derived from the retroperitoneal gland direct; the 21st generation of culture on serum was inoculated on July 8, 1908, when 16 days old; total duration of artificial cultivation: 340 days.

CALF 1383.
Subcutaneous.
Dose: 50.0 mg.
Killed: October 8, 1908.
92 days.
P.M.—General tuberculosis progressive, but not severe.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1923	Subcut.	10.0 mg.	K. 296 days	Slight G.T.
1924	Subcut.	10.0 mg.	K. 296 "	Chronic general progressive T.

CALF 1471.

Subcutaneous.
Dose: 80.0 mg.
Killed: October 6, 1908.
90 days.

P.M.—Slight progressive tuberculosis. Small ulcerated tumour at seat of inoculation; scattered caseo-purulent nodules in adjacent glands. About half-a-dozen perlsucht growths up to 8 mm., the majority in an early stage, were seen in the surface of the lungs; in the substance were scattered small reddish nodules. The spleen contained a dozen gritty tubercles, the thoracic glands scattered calcareous tubercles.

CULTURE.

The strain was derived from the pudic gland, and had been 48 days in artificial cultivation. The 4th generation of culture was used for inoculation on November 25, 1908, when 12 days old.

CALF 1489.

Subcutaneous.
Dose: 50.0 mg.
Died: January 6, 1909.
42 days.
P.M.—General tuberculosis.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
2070	Subcut.	10.0 mg.	D. 51 days	G. T.
2071	Subcut.	1.0 mg.	D. 78 "	G. T.

CULTURE.

The strain was derived from the bronchial gland, and had been 48 days in artificial cultivation. The 3rd generation of culture was used for inoculation on November 23, 1908, when 20 days old.

RABBIT 2069.

Subcutaneous.
Dose: 1.0 mg.
Died in 48 days.
P.M.—General tuberculosis.

CALF 1493.

Subcutaneous.
Dose: 45.0 mg.
Died: December 14, 1908.
21 days.
P.M.—General tuberculosis.

TABLE Q.

VIRUS H 90. "I.P."

CULTURE DERIVED FROM THE RETROPERITONEAL GLAND.

Separation by Animal Inoculation (Rabbits).

I.—NOVEMBER 5, 1907.

The strain was derived from the human retroperitoneal gland, and had been in artificial cultivation a total period of 94 days.

The culture used was the 8th generation, 14 days old, on bovine serum.

APRIL 14, 1909.

SEPARATION EXPERIMENT ON GLYCERIN MEDIA.

The strain was derived from the human retroperitoneal gland, and had been cultivated on glycerin-serum for four months; it was then sown on the serum and the resulting growth inoculated (33rd generation, 8 days old).

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1551	Intrav.	1.0 mg.	D. 26 days	G. T.
1552	Intrav.	0.1 mg.	D. 79 "	T. of lungs and kidneys.
1553	Subcut.	10.0 mg.	K. 111 "	G. T.
1554	Subcut.	10.0 mg.	K. 111 "	G. T.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
2301	Intrav.	0.1 mg.	D. 19 days	General miliary T. G.T.
2300	Intrav.	0.01 mg.	D. 35 "	
2302	Intrav.	0.01 mg.	D. 28 "	General miliary T.

II.—MARCH 30, 1908.

The strain was derived from the same source and had been in cultivation a total period of 240 days.

The culture used was the 16th generation, 13 days old, on bovine serum.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1793	Intrav.	1.0 mg.	D. 32 days	G. T.
1794	Intrav.	0.1 mg.	D. 64 "	G. T.
1795	Intrav.	0.01 mg.	D. 116 "	G. T.

CULTURE.

Derived from the lung of Rabbit 1794. Inoculated on September 4, 1908, after 94 days cultivation. The 5th generation was used when 18 days old.

CULTURE.

Derived from the kidney of Rabbit 1795. Inoculated on October 13, 1908, after 81 days cultivation. The 6th generation was used when 22 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1992	Intrav.	0.1 mg.	D. 27 days	G. T.
1993	Intrav.	0.01 mg.	D. 28 "	G. T.
1994	Intrav.	0.01 mg.	D. 32 "	G. T.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
2040	Intrav.	1.0 mg.	D. 14 days	Acute G. T.
2041	Intrav.	0.1 mg.	D. 21 "	General miliary T. G. T.
2042	Intrav.	0.01 mg.	D. 36 "	

TABLE R.
VIRUS H 90. "I.P."
CULTURE DERIVED FROM THE RETROPERITONEAL GLAND.
Separation by Animal Inoculation (Goat).

CULTURE.

The strain was derived from the human retro-peritoneal gland, and had been in cultivation a total period of 103 days. The 10th generation, 14 days old, on glycerin-serum, was used for inoculation on November 14, 1907.

GOAT 55.

Subcutaneous.
Dose : 50.0 mg.
Killed : February 25, 1908.
103 days.

P.M.—Small local lesion. Left prescapular gland contained caseous gritty nodules. The lungs showed fairly numerous small grey fibrous tubercles ; each kidney contained one tubercle. In most of the mesenteric glands there were soft yellow gritty tubercles and patches. The left half of the udder contained a number of fibrous tubercles with caseous centres and two hard nodules with caseous foci ; the right showed a small firm patch beset with caseous points. Supramammary lymph glands normal.

CULTURE.

The strain was derived from the prescapular gland of Goat 55, and was inoculated on December 22, 1908, after 301 days artificial cultivation. The culture used was the 13th generation, 13 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
2097	Intrav.	1.0 mg.	D. 103 days	T. of lungs, kidneys, and muscles.
2098	Intrav.	0.1 mg.	K. 136 "	A few tubercles in lungs only.
2099	Intrav.	0.1 mg.	K. 136 "	Slight T. of lungs, kidneys and inguinal glands.

Emulsion of prescapular gland into—
RABBITS.

1741	Subcut.	D. 145 days	G. T.
1742	Subcut.	D. 157 "	G. T.

CULTURE.

Derived from the lung of Rabbit 1741. The 4th generation, 13 days old, was used for inoculation on September 24, 1908.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
2013	Intrav.	1.0 mg.	D. 15 days	Acute miliary T.
2014	Intrav.	0.1 mg.	D. 22 "	G. T.
2015	Intrav.	0.01 mg.	D. 27 "	General miliary T.

CULTURE.

Derived from Guinea-pig 2791, inoculated on November 28, 1907, with 10.0 cc. of milk from the right half of the udder (died in 88 days, G. T.).

The 7th generation of culture, 11 days old, was used on August 14, 1908, for inoculating—

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1967	Intrav.	1.0 mg.	K. 167 days	T. of lungs and kidneys.
1968	Intrav.	0.1 mg.	K. 167 "	} Very slight T. of lungs and kidneys.
1969	Intrav.	0.01 mg.	K. 167 "	
1970	Subcut.	50.0 mg.	K. 167 "	Local lesion, T. of lungs (moderate), and of kidneys (slight).

TABLE S.

VIRUS H 90. "I.P."

CULTURE DERIVED FROM THE RETROPERITONEAL GLAND.

Investigation of Separate Colonies.

RABBIT 2019.

Inoculated intravenously with a fairly large dose of a serum culture (24th generation, 16 days old) derived from the retroperitoneal gland, on September 28, 1908.
Died of acute tuberculosis on October 18, 1908 (20 days).

CULTURE.

Single colonies were isolated from two egg tubes sown with an emulsion of spleen.

RABBITS inoculated with cultures derived from these colonies.

Date of Inoculation.	Number of Colony.	Age and Generation.	Number of Rabbit.	Method.	Dose.	Duration of Life.	Result.
Jan. 28, 1909	Col. 1	4th gen. ; 21 days old, on serum.	2136	Intrav.	0.1 mg.	D. 21 days	General miliary T.
			2135	Intrav.	0.01 mg.	D. 32 "	G. T.
"	Col. 2	4th gen. ; 21 days old, on serum.	2138	Intrav.	0.1 mg.	D. 21 "	General miliary T.
			2137	Intrav.	0.01 mg.	D. 33 "	G. T.
			2134	Intrav.	0.1 mg.	K. 104 "	Slight T. of kidneys, moderately severe disease of lungs, and severe T. of eyes and lachrymal glands.
Jan. 27, 1909	Col. 5	4th gen. ; 20 days old, on serum.	2133	Intrav.	0.01 mg.	D. 17 "	Slight T. of lungs. Death from coccidiosis.

GUINEA-PIG 3300.

Inoculated intraperitoneally with the same culture as Rabbit 2019, on September 28, 1908.
Killed 21 days later on October 19, 1908, and showed general tuberculosis.

CULTURE.

Single colonies were isolated from an egg tube sown from the pyloric gland.

RABBITS inoculated with cultures derived from these colonies.

Date of Inoculation.	Number of Colony.	Age and Generation.	Number of Rabbit.	Method.	Dose.	Duration of Life.	Result.
Jan. 7, 1909	Col. 1	4th gen. ; 19 days old, on serum.	2109	Intrav.	1.0 mg.	D. 121 days	T. of lungs and kidneys.
			2110	Intrav.	0.1 mg.	K. 170 "	Very slight T. of lungs and kidneys.
			2111	Intrav.	0.01 mg.	K. 170 "	Very slight T. of lungs.
Jan. 27, 1909	Col. 2	5th gen. ; 21 days old, on serum.	2130	Intrav.	0.1 mg.	K. 104 "	Slight T. of lungs and kidneys.
			2129	Intrav.	0.01 mg.	K. 104 "	
"	Col. 3	5th gen. 21 days old, on serum.	2132	Intrav.	0.1 mg.	K. 104 "	Slight T. of lungs and kidneys.
			2131	Intrav.	0.01 mg.	K. 104 "	Slight T. of lungs only.

FULL POST-MORTEM NOTES OF THE CALVES INOCULATED.

									PAGE
Virus H 13 "A.D."	Calf 1175	...	...	...	...	...	...	...	50
	Calf 1177	...	...	...	...	...	...	...	51
	Calf 1237	...	...	...	...	...	...	...	52
	Calf 1327	...	...	...	...	...	...	...	54
	Calf 1207	...	...	...	...	...	...	...	55
	Calf 1301	...	...	...	...	...	...	...	57
	Calf 1309	...	...	...	...	...	...	...	58
	Calf 1337	...	...	...	...	...	...	...	59
	Calf 1343	...	...	...	...	...	...	...	60
Virus H 49. "T.C."	Calf 1191	...	...	...	...	...	...	...	61
	Calf 1193	...	...	...	...	...	...	...	61
	Calf 1213	...	...	...	...	...	...	...	62
	Calf 1263	...	...	...	...	...	...	...	64
	Calf 1347	...	...	...	...	...	...	...	66
	Calf 1387	...	...	...	...	...	...	...	67
	Calf 1415	...	...	...	...	...	...	...	68
	Calf 1413	...	...	...	...	...	...	...	69
Virus H 60. "W.B."	Calf 1501	...	...	...	...	...	...	...	69
	Calf 1203	...	...	...	...	...	...	...	71
	Calf 1481	...	...	...	...	...	...	...	72
Virus H 90. "I.P."	Calf 1425	...	...	...	...	...	...	...	73
	Calf 1489	...	...	...	...	...	...	...	74
	Calf 1493	...	...	...	...	...	...	...	75

NOTE.—The full post-mortem notes of three calves, Calves 1099, 1107 and 1109, which were inoculated to test the virulence of the bronchial gland strain from Virus H 60. "W.B.", will be found on pages 279–282 of the Report on Cases of Human Tuberculosis (other than lupus).

The full post-mortem notes of Calves 1383 and 1471, which were inoculated to test the virulence of the retroperitoneal gland strain of Virus H 90. "I.P.", together with the post-mortem notes of Goat 55, will be found on pages 460 and 461 of the same report.

CALF 1175. Virus H 13. "A.D."

Subcutaneous inoculation of culture derived from Calf 301 (thoracic gland), direct.

Dose—100·0 milligrammes.

Date of Inoculation—March 23, 1907. [Age, 13 weeks.]

Killed when in good health—June 12, 1907. [81 days after inoculation.]

Clinical Notes.

A large pendulous tumour developed at the seat of inoculation on the left side of the neck; on the 27th day this measured 18 by 9 cm. The tissues of the dewlap were slightly oedematous, and the left prescapular gland was very large, measuring 14 cm. in length. The general health of the animal was unimpaired.

Shortly afterwards the tumour opened and discharged caseo-purulent matter, subsequently diminishing in size. On the 52nd day it was firm and slightly raised, measuring 13 by 6 cm., and showing over the lower part an ulcer 4 cm. in greatest diameter, partly covered with a caseous scab. The prescapular gland was still considerably enlarged, measuring 11 cm. in length. The calf was apparently in good health.

On the 81st day the calf was killed.

Temperature.—During part of the second and third weeks the temperature was a little raised (maximum 39·3° C.); subsequently it was normal.

Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

			cwt.	qrs.	lbs.
March 23, 1907	...	...	1	0	14
June 12, 1907	...	...	1	3	8

Total gain of weight.—2 qrs. 22 lbs.

Average rate of gain per week —6·9 lbs.

POST-MORTEM EXAMINATION.

The carcass was in good condition.

Local Lesion.—The local lesion was firm and measured 10 by 7 by 4 cm.; it showed towards the lower extremity an oval punched-out ulcer 3·5 cm. in length with inverted edges; this ulcer communicated with a flat space in the centre of the tumour which contained a small amount of yellow tenacious caseopus; the space was surrounded by a zone of fibrous tissue, 1 cm. in greatest thickness, infiltrated with caseous streaks and foci; the muscles beneath this collapsed cavity or space were fibroid and closely beset with caseo-calcareous nodules ranging in size from a millet seed to a pea; the skin was much thickened and was adherent to the wall of the cavity.

Left Prescapular Gland.—The left prescapular gland measured 8·5 by 5 by 4·5 cm., and weighed 4 ozs.; on section it was tuberculous throughout, the greater portion being composed of dense pinkish yellow caseo-necrotic substance gritty around the periphery, the rest of caseo-calcareous tissue; the capsule was greatly thickened in places.

Right Prescapular Gland.—The right prescapular gland measured 5 by 2·3 by 1·4 cm. and showed in the cortex fairly numerous soft caseous nodules similar to those in the precrural glands (which see).

Left Prepectoral Glands.—The rounded prepectoral gland, the size of a swallow's egg, showed about half the cortex dense and caseous, while the rest was studded with caseo-calcareous tubercles.

The reniform gland was enlarged and contained a few caseous tubercles.

Cervical Glands.—One in the middle of the neck on the left side, the size of a large pea, was caseous throughout. Other cervical glands showed discrete yellow caseous nodules up to a hemp-seed in size.

A hæmolymp gland on the left side of the neck contained a soft caseous millet-seed sized tubercle.

Thorax.

Pleura.—On the costal pleura there were two hemp-seed sized tubercles, each with a minute yellow caseous centre. On the visceral pleura were two small pinkish fibrous nodules not caseous nor calcareous.

Lungs.—The lungs were crepitant throughout and showed no collapsed areas; they contained fairly numerous evenly distributed tubercles ranging in size from a mere point up to 2 mm. in diameter; the larger tubercles had yellow calcareous centres, the smaller ones were grey and homogeneous throughout. In the thin margin of one of the cephalic lobes there was a larger nodule with a caseo-calcareous centre.

Thoracic Glands.—The dorsal mediastinal and the bronchial glands were slightly enlarged and were closely beset with yellow caseo-calcareous tubercles, mainly discrete, but here and there aggregated together; the long mediastinal measured 3·3 by 2 by 2 cm.

The ventral mediastinal glands contained three or four caseous tubercles.

Heart.—On the pericardium covering the great vessels and the auricles, and along the interventricular sulci, were patches of tuberculous granulations, and here and there clusters of grey tubercles; on the surface of the ventricles there were a few isolated grey tubercles. There were a few patches of tuberculous granulations on the parietal pericardium as well as some discrete tubercles. Heart muscle and valves normal.

Larynx and Trachea.—Normal.

Abdomen.

Omentum.—On the inferior surface there were two loosely pedunculated millet-seed sized grey tubercles, each with a calcareous grain in the centre.

Peritoneum.—On the peritoneal surface of the diaphragm near the falciform ligament there was a slightly raised greyish pink nodule 1 cm. in diameter with a caseo-calcareous centre.

On the falciform ligament there were three or four small flattened caseous tubercles with grey margins.

Spleen.—The spleen was normal in size, and showed in the pulp fairly numerous evenly distributed soft yellow caseous nodules, varying in size from 1·5 to about 5 mm. in diameter; the nodules had grey fibrous margins and the larger ones were lobular in outline.

Liver.—The capsule of the liver showed three flattened grey slightly raised tubercles about 1·5 mm. in diameter, not involving the liver substance. On the anterior surface there were besides a few filmy grey fibrous tufts loosely attached to the capsule. In the substance of the liver two minute opaque points were seen, but no definite tubercles.

Portal Glands.—The portal glands, not obviously enlarged, were closely beset with discrete yellow milinary caseo-calcareous tubercles.

Coeliac Glands.—The coeliac glands were slightly enlarged, and closely beset with yellow milinary caseo-calcareous tubercles, as in the portal glands. The renal gland was similarly affected.

Kidneys.—In the cortex of the left near the surface were three, and in that of the right four, grey tubercles, the largest the size of a millet seed; two were calcareous in the centre, the others were homogeneous throughout.

Suprarenal Bodies.—Normal.

Testicles.—Normal.

Alimentary Tract.

Tongue, Pharynx, Tonsils.—Normal.

Intestines.—All the Peyer's patches showed scattered about in the lymphoid tissue soft yellow foci, mostly about the size of millet seeds; they were most conspicuous from the serous surface, and in several places were aggregated together to form large nodules; the mucous membrane over them was raised, and in some cases showed a small depression or pit but no actual ulcers. The large intestine was normal.

Mesenteric Glands.—All the mesenteric glands showed in the cortex fairly numerous yellow caseo-calcareous tubercles, mostly about the size of a millet seed or less, but several attaining the size of a hemp-seed; they were for the most part discrete, but here and there formed irregular calcareous patches.

Ileo-colic Glands.—The ileo-colic glands were most severely affected, and their substance extensively replaced by irregular caseo-calcareous patches.

Various Lymphatic Glands.

The Precurral Glands showed in the cortex numerous soft caseous nodules, varying in size up to about 4 mm. in diameter; the larger nodules were lobular in outline, and appeared to consist of several smaller ones united together; no calcareous foci were detected in the caseo-pus.

The Popliteal, Gluteal, Ischiatic, Iliac, and Lumbar Glands contained similar nodules in varying number. There were similar nodules in the *Submaxillary, Retropharyngeal, and Parotideal Glands*, but these were generally larger, and had deeply congested margins.

Microscopical Examination.

Emulsion of Prescapular Gland.—Tubercle bacilli numerous.

Emulsion of Popliteal Gland.—Tubercle bacilli scanty.

Emulsion of Mediastinal Gland.—Tubercle bacilli scanty.

Tubercle from Intestine.—One tubercle bacillus seen.

Focus from Liver.—No tubercle bacilli seen.

Animals Inoculated.

Calf 1237 was inoculated subcutaneously with 20 cc. of emulsion made from the prescapular gland.

Rabbit 1336 was inoculated subcutaneously with the same emulsion. (Died 78 days, G.T.)

Rabbits 1337 and 1338 were inoculated subcutaneously with an emulsion made from the mediastinal gland. (Died 92 and 47 days, G.T.)

CALF 1177. Virus H 13. "A.D."

Subcutaneous inoculation of culture derived from Calf 301 (thoracic gland), direct.

Dose—50·0 milligrammes.

Date of Inoculation—March 23, 1907. [Age about 12 weeks.]

Killed when in good health—July 11, 1907. [110 days after inoculation.]

Clinical Notes.

A prominent tumour developed at the seat of inoculation on the left side of the neck.

On April 19 it measured 14 by 8 cm. The left prescapular gland was then very large—12 cm. in length; the muscle between the tumour and the gland was slightly thickened. The calf was in good health.

On May 14 the tumour was pear shaped, measuring 14 by 7 cm. The gland was 10 cm. in length.

The calf at this time was a little thinner, and the rate of respiration seemed a little increased; but it quickly recovered, and during the remaining eight weeks of the experiment looked well and fat.

On July 11 the tumour was found to have opened and to be discharging caseo-pus; the calf was therefore killed on this day.

Temperature.—The temperature rose on the 10th day, reaching a maximum of 40·6° C. on the 14th day. It then slowly returned to the normal and remained normal subsequently.

Tuberculin Test.—July 5, 1907. [104 days after inoculation.] Reacted. Rise of temperature, 1·8° C.

Weights.

	March 23, 1907	July 11, 1907	cwt.	qrs.	lbs.
	0	3	17
	1	3	9

Total gain of weight.—3 qrs. 20 lbs.

Average rate of gain per week.—6·5 lbs.

POST-MORTEM EXAMINATION.

The carcass was in very good condition.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a firm tumour, measuring 10 by 6·5 by 4·5 cm., the skin towards the upper extremity of which showed a small opening at the bottom of a funnel shaped depression through which thick caseo-pus could be expressed.

On section the tumour was lenticular in outline (plano-convex), and was composed of a dense pinkish yellow caseous sequestrum, and a fibrous capsule from which the caseous mass was almost completely separated by thick caseo-pus; the capsule was lined internally with a layer of granulation tissue 1·5 mm. in thickness, containing here and there calcareous grains; the skin over the tumour was much thickened.

Left Prescapular Gland.—The left prescapular gland measured 8·2 by 5·1 by 4 cm.; on section it was composed almost throughout of dense pinkish yellow caseous tissue, gritty around the peripheral parts; at one extremity there was some normal-looking gland tissue which was very oedematous and contained discrete calcareous tubercles. The capsule was much thickened, especially on the convex surface.

Right Prescapular Gland.—The right prescapular gland measured 5·5 by 2·5 by 1 cm. It was oedematous (recent tuberculin inoculation) and contained scattered calcareous tubercles.

Prepectoral Glands.—On the left side one was very oedematous but free from tubercles; two others each contained two calcareous tubercles.

Two on the right side each contained two or three calcareous tubercles.

Cervical Glands.—On the left side a midcervical gland showed a calcareous patch. Other cervical glands on this side and all those on the right contained scattered calcareous tubercles.

*Thorax.**Pleura.*—Normal.

Lungs.—The lungs were pinkish in colour, crepitant throughout, and collapsed normally; they contained evenly distributed though not very numerous tubercles, ranging in size from 1 to 2 mm. in diameter; the larger ones were yellow and calcareous with grey margins; the smaller ones were grey and had glassy gritty centres.

Thoracic Glands.—The bronchial and mediastinal glands were slightly enlarged and showed around the cortices irregular calcareous patches, composed of aggregated tubercles, and discrete calcareous tubercles.

Ventral Mediastinal Glands.—There were a few small calcareous tubercles in each.

Heart, Larynx, and Trachea.—Normal.

Abdomen.

Omentum.—On the ventral surface there were about a dozen pedunculated lenticular tubercles with calcareous centres, the largest about twice the size of a millet seed.

Peritoneum.—Normal.

Spleen.—The spleen, normal in size, showed on section fairly numerous evenly distributed yellow calcareous tubercles with thin fibrous capsules, ranging from 1 to 2 mm. in diameter.

Liver.—Very sparsely scattered throughout the substance of the liver were minute pearly or glassy calcareous tubercles which readily shelled out.

Portal Glands.—The portal glands, not enlarged, contained fairly numerous irregular calcareous tubercles, here and there aggregated together into small groups.

Kidneys.—Normal.

Suprarenal Bodies.—In the cortex of the left there was a grey tubercle, calcareous in the centre, 2 mm. in diameter.

The right was normal.

Alimentary Tract.

Tongue, Pharynx, Tonsils.—Normal.

Intestines.—Several of the Peyer's patches in the

small intestine contained soft yellow submucous tubercles slightly gritty from calcification. Large intestine normal.

Mesenteric and Ileo-colic Glands.—These glands were little if at all enlarged, but were rather extensively tuberculous, containing numerous calcareous patches and nodules as well as discrete tubercles; they were not quite so severely affected as the bronchial and mediastinal glands.

Eyes.—Normal.

Mammary Gland.—Normal.

Various Lymphatic Glands.

The Precural Glands showed in the cortices scattered yellow calcareous tubercles, irregular in outline, the largest about the size of a millet seed; they readily shelled out from the gland substance.

The Popliteal, Axillary, Submaxillary, Hyoid, Retro-pharyngeal, Gluteal, Ischiatic and Pudic, Lumbar and Iliac Glands contained similar tubercles.

The Renal Gland contained similar but rather more numerous tubercles.

Coeliac Glands.—One contained a calcareous patch and a number of discrete calcareous tubercles; the rest contained discrete calcareous tubercles as in the peripheral lymphatic glands

Microscopical Examination.

Emulsion of Prescapular Gland.—Tubercle bacilli moderately numerous.

Emulsion of Spleen.—Six tubercle bacilli seen.

Animals Inoculated.

One rabbit, No. 1380, was inoculated subcutaneously with an emulsion made from the prescapular gland. (Died 61 days, G.T.)

Two rabbits, Nos. 1381 and 1382, were inoculated subcutaneously with an emulsion made from the spleen. (Died 167 and 110 days, G.T.)

CALF 1237. Virus H 13. "A.D."

Subcutaneous inoculation of emulsion of the left prescapular gland from Calf 1175.

Dose—20.0 cc. of emulsion containing numerous tubercle bacilli.

Date of Inoculation—June 12, 1907. [Age about 15 weeks.]

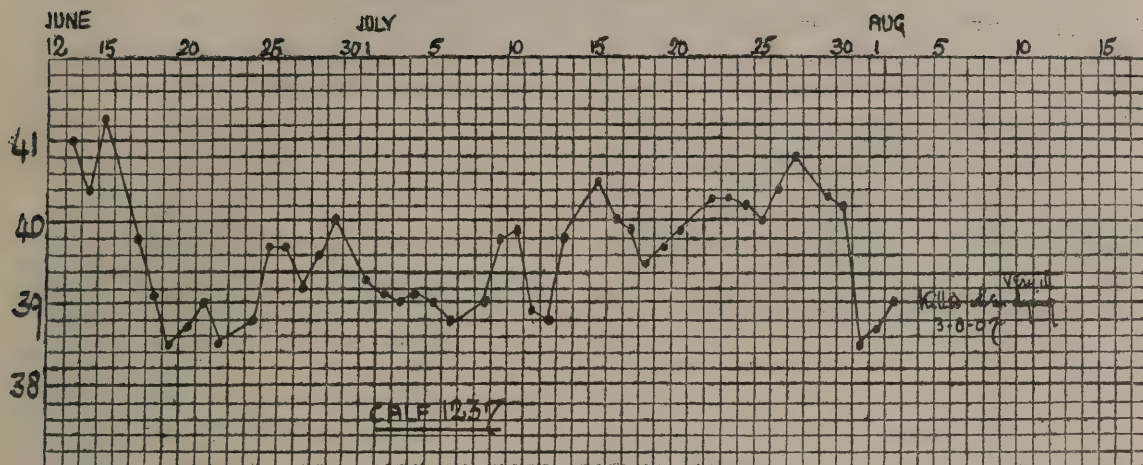
Killed when very ill—August 3, 1907. [52 days after inoculation.]

Clinical Notes.

The course of the disease was similar to that usually seen in calves suffering from acute tuberculosis. On

Saturday, August 3, the calf was very ill, emaciated, and breathing rapidly, and appeared likely to die in a day or two. It was therefore killed.

Temperature.



Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

	cwt.	qrs.	lbs.
June 12, 1907 ...	1	0	17
August 3, 1907 ...	1	0	1

Total loss of weight.—16 lbs.

Average rate of loss per week.—2.1 lbs.

POST-MORTEM EXAMINATION.

The carcass was very thin.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a firm elongated tumour measuring 17 by 9.5 cm. by 5 cm. in thickness (the latter measurement including skin and muscle), and weighing 1 lb. 5 ozs.

On section it was composed of three layers, the outer one of skin, 1 cm. in thickness, closely beset with congested caseous tubercles, the inner one of dense pinkish yellow caseo-necrotic substance, the internal one of fibroid muscle tissue closely infiltrated with irregular caseous nodules of various sizes.

Left Prescapular Gland.—The left prescapular gland measured 9 by 5 by 5 cm. and weighed 4 ozs., and was composed practically throughout of dense pinkish yellow caseo-necrotic substance, showing many petechial points of hæmorrhage; the capsule was much thickened.

Right Prescapular Gland.—The right prescapular gland measured 4 by 1.5 by 0.8 cm., and appeared normal on section.

Prepectoral Glands.—On the left side there were four; one rounded and about 1.3 cm. in diameter was caseous throughout, another about the same size was indurated and beset with caseous tubercles, a third was very large, 4 cm. in length, oedematous, and showed scattered whitish foci; the fourth, a very small gland, contained a few early tubercles.

On the right side one was speckled with minute greyish-white foci; another contained three caseous tubercles.

Cervical Glands.—On the left side in the lower part of the neck there was a firm gland 3 cm. in length which was caseous throughout; in the upper part of the neck a gland was caseating throughout, but was not so advanced as that in the lower; a gland near the latter showed numerous caseous tubercles in the cortex; a mid-cervical gland contained one caseous tubercle.

On the right side a lower cervical gland had some caseating patches in the cortex; the rest were normal.

Axillary Glands.—There were three caseous tubercles in the right axillary gland and one in the left.

Thorax.

Pleura.—The lymphatic fringes along the margins of the ribs were here and there very slightly hypertrophied and contained a few miliary tubercles.

On the diaphragmatic pleura there was a cluster of caseating tubercles and a few patches of tuberculous granulations. There were two or three grey millet-seed sized tubercles on the pericardial pleura.

Lungs.—The lungs weighed 6 lbs. 10 ozs. The cephalic, the right middle, and the antero-ventral portions of the caudal lobes were extensively hepatized, very little crepitant lung tissue remaining and this chiefly along the dorsal borders, and their surfaces were closely studded with raised grey nodules, the largest about the size of a hemp seed or more; the surfaces of the posterior parts of the caudal lobes were smooth and showed under the pleura numerous nodules, many of which were surrounded by hepatized patches, some occupying the whole of a lobule; on section the parenchyma of the lung was closely beset with grey nodules with yellow caseous centres similar to those seen from the surface; in the caudal lobes several lobules were uniformly dense and caseating.

Thoracic Glands.—The dorsal mediastinal and bronchial glands were enlarged, weighing together 6 ozs.; the long mediastinal gland measured 11 cm. in length. On section, the cortices were composed almost entirely of firm grey translucent tissue mottled with irregular caseous foci and small patches in places forming a network; many of the smaller glands were very oedematous.

Heart.—Around the margin of the left auricle were three grey miliary tubercles. In the wall of the right auricle there was a millet-seed sized caseous tubercle. The heart was otherwise normal.

Larynx and Trachea.—Normal.

Abdomen.

There was no fluid in the peritoneal cavity.

Omentum and Peritoneum.—On the ventral surface of the omentum there were two millet-seed sized grey tubercles. The peritoneum was normal.

Spleen.—The pulp was closely beset with firm caseous nodules with grey margins, varying from 1.5 to 3 mm. in diameter; there were no tubercles on the surface.

Liver.—The liver showed on the surface numerous nodules; some were slightly raised and flattened out up to 3 mm. in diameter, others were situated just beneath the capsule, while others again were dimly seen in the depth; on section the substance was moderately closely beset with tubercles which varied from 1 to 2.5 mm. in diameter; the smaller ones were greyish white, some being distinctly more opaque in the centre than around the margins, the larger ones had yellowish centres.

Portal Glands.—The portal glands were enlarged and closely beset with caseating nodules in places confluent.

Kidneys.—Many of the lobules showed atrophied and fibroid patches in the cortex to which the capsule was adherent; in one of the lobules the greater part of the cortex was replaced by cheesy purulent substances; the cortex of each kidney contained fairly numerous caseating nodules varying from a pin's head to a hemp seed.

Suprarenal Bodies.—These appeared normal.

Coeliac Glands.—Two were slightly enlarged and showed, on section, patches composed of aggregated caseating nodules as well as discrete caseating nodules; another contained one caseating nodule, irregular in outline, the size of a hemp seed.

Renal Gland.—The renal gland was enlarged and closely beset with irregular caseous nodules varying up to 2.5 mm. in diameter.

Lumbar Glands.—The lumbar glands resembled the renal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Submaxillary, Retropharyngeal and Parotideal Glands.—Each contained a few miliary caseous tubercles.

Small Intestines.—All the Peyer's patches contained miliary caseous tubercles in small number.

Large Intestine.—Normal.

Mesenteric Glands.—The mesenteric glands, not enlarged, contained scattered discrete caseating nodules, the largest 5 mm. in diameter.

Ileo-colic Glands.—The ileo-colic glands contained numerous small tubercles.

Testes.—Normal.

Eyes.—Normal.

Various Lymphatic Glands.

Preaural Glands.—The right was normal; the left contained three caseous tubercles.

Popliteal, Gluteal and Pudic Glands.—Normal.

Microscopical Examination.

Emulsion of Left Prescapular Gland.—Tubercle bacilli moderately numerous.

Emulsion of Portal Gland.—Tubercle bacilli scanty.

Emulsion of Bronchial Gland.—Tubercle bacilli scanty.

Tubercle from Heart.—Tubercle bacilli, two seen.

Smear from Right Suprarenal.—No tubercle bacilli seen.

Smear from Faeces.—No tubercle bacilli seen.

CALF 1327. Virus H 13. "A.D."

Subcutaneous inoculation of culture derived from the bronchial gland of Calf 1237.

Dose—50.0 milligrammes.

Date of Inoculation—December 30, 1907. [Age about 11 weeks.]

Died—January 26, 1908. [27 days after inoculation.]

Clinical Notes.

The course of the disease was similar to that usually seen in calves suffering from acute tuberculosis.

Temperature.—The temperature rose to 39.6° C. on the third day and reached a maximum of 40.2° C. on the 8th day. It subsequently remained above normal (between 39.0 and 39.9° C.) for 15 days. During the following three days the temperature fell one degree (to 38.0° C.), and on the morning of the next day the animal was found dead.

Weights.

			grs.	lbs.
December 30, 1907	...	...	3	20
January 26, 1908	...	...	3	13

Total loss of weight.—7 lbs.

POST-MORTEM EXAMINATION.

The body was thin.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a caseo necrotic mass, semilunar on longitudinal section, measuring 13 by 9 by 3 cm.; both the skin and the muscles were infiltrated, and the prescapular gland was adherent to it.

Left Prescapular Gland.—The left prescapular gland measured 9 by 4.5 by 4.5 cm., and was composed throughout of dense yellow caseated substance.

Prepectoral Glands.—The prepectoral glands on both sides contained discrete miliary caseous tubercles.

Right Prescapular Gland.—The right prescapular gland measured 5 by 2 by 1 cm., and showed in the cortex numerous discrete miliary caseous tubercles.

Thorax.

Pleura.—The costal and diaphragmatic pleura on the right side was thickly covered with caseous miliary tubercles; there were numerous similar tubercles on the pericardial pleura; on the left parietal pleura miliary tubercles were very sparsely scattered, but in the fringes here and there were groups of grey granules.

Lungs.—The lungs were heavy and weighed 4 lbs. 13 ozs. The anterior and right middle lobes and the greater portions of the posterior lobes were dark red and solid; the rest of the caudal lobes was congested and showed irregular diffuse areas of consolidation; the tissue of the lungs was closely and evenly beset with caseating miliary tubercles.

At the root of the right lung in front of the bronchus there was a collection of thick greenish pus with a fibrous capsule. It was not connected with a bronchus and appeared to be a suppurating gland.

Thoracic Glands.—The bronchial and mediastinal glands were enlarged; their cortices were closely beset with grey caseating tubercles, the majority of which had coalesced forming irregular patches.

Heart.—Muscle and valves normal. There were several clusters of tubercles on the pericardium at the root of the great vessels and a crop of miliary caseous tubercles on the parietal pericardium.

Abdomen.

Omentum and Peritoneum.—The ventral surface of the omentum was rather thickly covered with miliary caseating tubercles.

The parietal peritoneum was normal.

Spleen.—The spleen was much enlarged and weighed 14 ozs.; the pulp was firm and was packed almost as closely as possible with miliary caseating tubercles with reddish margins, with difficulty differentiated from the small amount of red pulp existing between the tubercles; the cut surface had a coarsely granular appearance.

Liver.—The substance of the liver was closely and evenly beset with greyish-white miliary tubercles.

Gall-bladder.—There were a few tubercles in the wall of the gall-bladder.

Portal Glands.—The portal glands were enlarged and showed around the cortices irregular grey patches containing caseous foci and here and there a caseous network.

Kidneys.—Each kidney showed in the cortex fairly numerous grey miliary tubercles with caseous centres.

Suprarenal Bodies.—Each contained about half-a-dozen submiliary greyish-white tubercles.

The Coeliac, Lumbar, and Renal Glands resembled

the portal, showing in the cortex aggregations of caseating miliary tubercles.

Testes.—Normal.

Alimentary Tract.

The pharyngeal, laryngeal and tracheal mucous membranes showed numerous miliary tubercles.

There were tubercles under the mucous membrane of the tongue at the base and margins.

Intestines.—There were extremely numerous miliary caseous submucous tubercles throughout the whole length of the small intestine; many of the Peyer's patches were exceptionally closely beset.

The large intestine also showed numerous submucous caseous tubercles.

Various Lymphatic Glands.—All the peripheral lymphatic glands and the mesenteric glands were closely beset with caseous miliary tubercles.

CALF 1207. Virus H 13. "A.D."

Subcutaneous inoculation of culture derived from Calf 301, direct. [The culture had been growing for two generations on glycerin-serum.]

Dose—100·0 milligrammes.

Date of Inoculation—March 26, 1907. [Age 13 weeks.]

Killed when in good health—June 26, 1907. [92 days after inoculation.]

Clinical Notes.

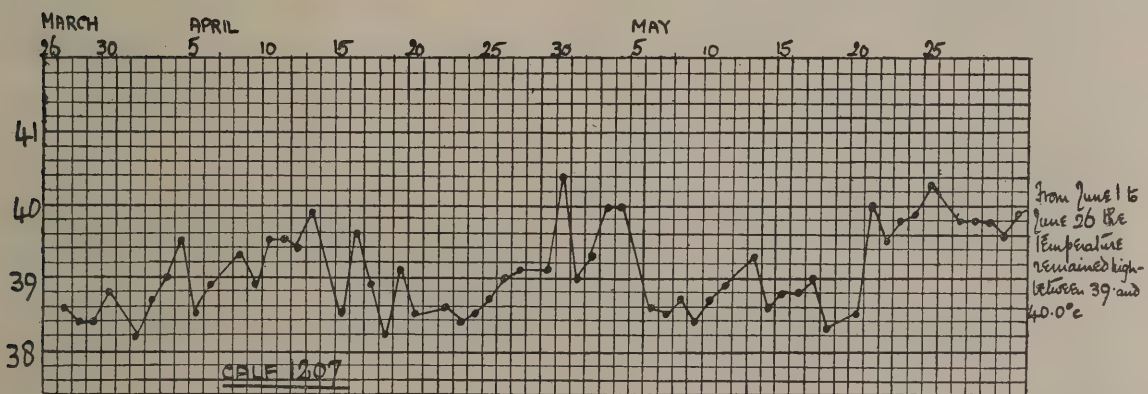
A tumour of moderate size developed at the seat of inoculation on the left side of the neck. On the 24th day it was pear-shaped, measuring 9 by 6 cm.; on the 51st day it measured 11 by 6 cm. and was fluctuating.

The left prescapular gland became moderately enlarged, and on the 51st day measured 9 cm. in length.

No changes of importance took place subsequently in the local conditions.

The calf showed no signs of illness during the experiment.

Temperature.



Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

			cwt.	qrs.	lbs.
March 26, 1907	...	...	1	0	16
June 26, 1907	...	...	1	2	21

Total gain of weight.—2 qrs. 5 lbs.

Average rate of gain per week.—4·7 lbs.

POST-MORTEM EXAMINATION.

The carcass was in fair condition.

Local Lesion.—On the left side of the neck there was a somewhat pear-shaped fluctuating tumour measuring 7 by 5 by 3 cm.; on section it was found to be a cyst, surrounded by a fibrous wall lined with a thin layer of caseous substance rough and shaggy internally, and filled with turbid watery fluid and caseo-necrotic masses and shreds.

Left Prescapular Gland.—The left prescapular gland measured 7.5 by 4.5 by 3 cm., and on section showed about three-quarters of the cortex caseous, parts being homogeneous and of a salmon-pink colour, the rest yellow and highly calcareous; in the remainder of the gland were discrete calcareous tubercles.

Right Prescapular Gland.—The right prescapular gland measured 3.5 by 1.8 by 1 cm. and contained a few calcareous tubercles.

Prepectoral Glands.—On the left side the rounded gland was slightly enlarged and closely beset with minute calcareous tubercles. Another gland contained one small calcareous tubercle. Those on the right side were normal.

Cervical Glands.—One in the middle of the neck on the left side and two near the articulation of the jaw showed each one or two calcareous tubercles. The rest were normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were pinkish in colour and were crepitant throughout with the exception of two or three hepatised lobules in the caudal lobes; the lung parenchyma contained fairly numerous pale grey tubercles somewhat irregular and occasionally indefinite in outline, varying in size up to 1 mm.; they were most numerous in the caudal lobes, sparsely scattered in the left cephalic and almost absent in the right cephalic. The larger tubercles all had calcareous centres, but most of the smaller ones were homogeneous throughout.

Thoracic Glands.—The mediastinal and bronchial glands were almost twice the normal in size and were closely beset with calcareous tubercles, in places loosely aggregated together, especially in the larger glands, to form irregular calcareous patches.

Heart.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—The spleen was normal in size and showed attached to the capsule a greyish pink flattened nodule, 1 cm. in diameter, containing calcareous grains in the centre; on section the pulp contained fairly numerous small calcareous tubercles with grey margins, the largest about 1 mm. in diameter; 20 were counted in an area 5 cm. square.

Liver.—The liver appeared normal on the surface and on section.

Gall-bladder.—Normal.

Portal Glands.—The portal glands were slightly enlarged, and their cortices were closely beset with irregular yellow calcareous miliary tubercles, forming in places small groups.

Kidneys.—In the cortex of each kidney there were about half-a-dozen translucent grey tubercles slightly opaque in the centre, the largest 1 mm. in diameter; some were situated just under the capsule while others were found in the depth of the cortex.

Suprarenal Bodies.—In the cortex of the left suprarenal there was a millet seed sized tubercle with a calcareous centre and a fibrous margin. The right was normal.

Coeliac Glands.—The cortex of one was rather closely beset with small irregular calcareous tubercles; in the others tubercles were more sparsely scattered.

Renal and Lumbar Glands.—These were slightly enlarged, and resembled on section the first coeliac gland.

Iliac Glands.—In the left there were two minute calcareous tubercles. The right contained rather more numerous tubercles, two of which were larger than millet seeds.

Alimentary Tract.

Tongue, Pharynx, Tonsils.—Normal.

Submaxillary and Retro-pharyngeal Glands.—These contained fairly numerous small calcareous tubercles.

Parotideal Glands.—In the parotid glands there were similar but not so numerous tubercles.

Small Intestines.—A Peyer's patch towards the anterior end contained a yellow slightly gritty tubercle the size of a pin's head. In the long terminal patch there were several similar foci and a few small ulcers in the mucous membrane with slightly raised margins but with no caseation in the base.

Large Intestine.—Normal.

Mesenteric Glands.—All showed in the cortex calcareous patches composed of aggregated tubercles, as well as discrete calcareous tubercles.

Ileo-colic Glands.—The ileo-colic glands were closely beset with calcareous tubercles and resembled the mediastinal and portal glands.

Gastric and Colic Glands.—These contained a few discrete calcareous tubercles.

Testicles.—Normal.

Various Lymphatic Glands.

Axillary.—The right contained a pinhead-sized calcareous tubercle. In the left were two calcareous grains.

Popliteal.—The right was normal. The left contained two calcareous foci.

Precrural.—In the cortex of each there were scattered tubercles varying up to 1 mm. in diameter; a few of the tubercles were caseous and softened, but the majority were quite calcareous.

Pudic.—One contained a millet-seed sized caseous tubercle.

Ischiatic.—Normal.

Gluteal.—In one there was an irregular yellow calcareous tubercle; the other was normal.

Microscopical Examination.

Emulsion of Prescapular Gland.—Tubercle bacilli numerous.

Emulsion of Mediastinal Gland.—Tubercle bacilli fairly numerous.

Animals Inoculated.

Two rabbits (1354 and 1355) were inoculated subcutaneously with the prescapular gland emulsion, and two (1356 and 1357) with the emulsion made from the mediastinal gland.

1354 and 1357 died of G.T. in 92 and 53 days respectively; the others died prematurely.

CALF 1301. Virus H 13. "A.D."

Subcutaneous inoculation of culture derived from a large (eugonic) colony [No. 2] on a glycerin-serum plate sown from Guinea-pig 2491. This guinea-pig had been injected with the "Calf 301" strain of culture.

Date of Inoculation—November 12, 1907. [Age about five months.]

Dose—100·0 milligrammes.

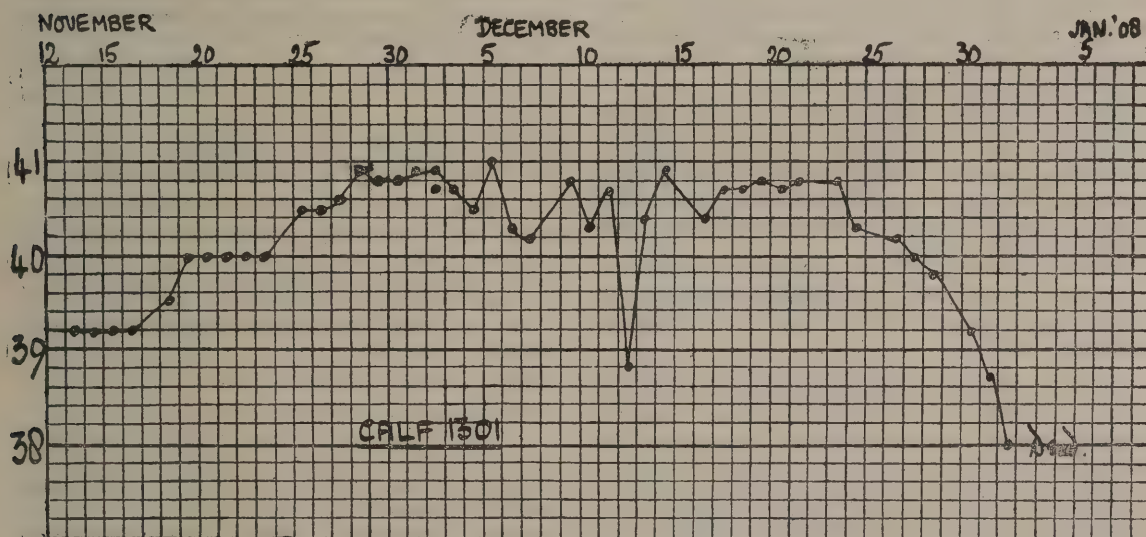
Died—January 2, 1908. [51 days after inoculation.]

Clinical Notes.

Twenty-three days after inoculation there was a prominent fluctuating pear-shaped tumour measuring 16 by 9 cm. at the seat of inoculation; the adjacent prescapular gland was enlarged and very hard, measuring 11 cm. in length.

The coat was somewhat staring, and the animal appeared to have lost flesh, otherwise the condition was fairly good.

The disease subsequently progressed slowly; the animal gradually became weak and very emaciated, and the respiration laboured, and it died on the 51st day after inoculation.

Temperature.

Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

		cwt.	qrs.	lbs.
November 12, 1907	...	1	2	18
January 2, 1908...	...	1	0	22

Total loss of weight.—1 qr. 24 lbs.

Average rate of loss per week.—7 lbs.

POST-MORTEM EXAMINATION.

The carcass was emaciated.

Local Lesion.—The tumour at the seat of inoculation was pear-shaped, prominent, and fluctuating, it weighed 1 lb. 2 ozs. and measured 16 by 9 by 7 cm.

On section a large cavity was seen in the upper part filled with yellow serous fluid containing flakes of caseous material and crossed by fibrous trabeculae. The remainder of the tumour was composed of pinkish-yellow caseo-necrotic substance, breaking down into ragged masses around the cavity, firm elsewhere.

The overlying skin and the subjacent muscles were infiltrated to a slight extent.

Left Prescapular Gland.—The left prescapular gland measured 12·5 by 7 by 4 cm., and was composed throughout of dense pinkish yellow caseated tissue showing no sign of calcification.

Prepectoral Glands.—The rounded gland on the left side measured 1·5 cm. in diameter, and was packed with confluent yellowish-white caseating tubercles.

The kidney-shaped gland was swollen and slightly congested, and showed one small caseating nodule in the cortex.

A third gland on this side was normal.

The prepectoral glands on the right side were normal.

Right Prescapular Gland.—The right prescapular gland measured 5 by 2·4 by 1 cm. It was oedematous

and contained a number of irregular caseating tubercles, the largest about 2 mm. in diameter.

Cervical Glands.—A small mid-cervical gland on the left side contained caseating patches; one on the right side showed two caseating tubercles.

The upper cervical glands on the left side were normal; one on the right side contained a caseating tubercle.

Axillary Glands.—The right axillary gland contained a hempseed-sized caseating nodule in the cortex; the left was normal.

Thorax.

Lungs.—The lungs were very heavy, weighing 8 lbs. 14 ozs.; they almost completely filled the chest.

The surface of the whole of the left lung and of the upper lobe of the right was mottled with dark red confluent patches of consolidation; the surface of the remaining lobes of the right lung was almost entirely dark red in colour, small patches and islands of pink tissue alone remaining.

The substance of both lungs under the pleura was thickly and evenly beset with greyish-yellow caseating nodules sometimes confluent, ranging from 1 to 8 mm. in diameter. The upper lobes on both sides were slightly less severely affected than the rest of the lung.

On section of the lung the tubercles appeared even more numerous than they did from the surface, and large caseating patches of various sizes were seen, the largest measuring 1·5 by 0·7 cm.; the condition of the organ on section resembled that on the surface, the right lung being to a large extent dark red and consolidated, the left showing only small patches of consolidation.

Thoracic Glands.—The thoracic glands were very much enlarged and weighed altogether 14 ozs. The long mediastinal gland measured 15 by 6 by 2·7 cm.

On section the cortices were firm and composed of grey translucent fibroid tissue closely beset with yellow caseous areas.

Heart and Pericardium.—Normal.

Larynx and Trachea.—Normal.

Pleura.—There was one loosely attached caseating flattened nodule measuring 8 by 6 mm. on the pleura just behind the second rib on the right side; no tubercles were seen elsewhere on the parietal pleura.

On the pleural surface of the diaphragm there was a group of small loosely attached lenticular tubercles.

There were two caseating nodules situated close together in the wall of the diaphragm, the larger about a hemp seed in size. The peritoneal surface of the diaphragm was normal.

Abdomen.

Omentum and Peritoneum.—On the omentum there was one loosely attached flattened caseating tubercle 0.5 cm. in greatest diameter. The peritoneum was normal.

Spleen.—The spleen was not enlarged, and on section showed scattered yellow caseating tubercles, the largest about 2 mm. in diameter. About sixty were counted in a longitudinal section.

Liver.—The liver was fatty looking and weighed 5 lbs. 6 ozs. The surface was mottled and showed thinly scattered tubercles with yellow centres and translucent margins varying in size from a mere point up to 4 mm. in diameter; one or two of the larger projected on the surface, many were dimly seen through the capsule.

Sparsely scattered tubercles were seen on section.

Portal Glands.—The portal glands were enlarged and oedematous and were packed with coalescing caseating nodules.

Kidneys.—About thirty yellowish-white tubercles were counted on the surface of the left kidney varying from 1 to 4 mm. in diameter. Similar tubercles were sparsely scattered throughout the cortex.

The right kidney was similarly affected.

Suprarenal Bodies.—In the cortex of the left three yellow caseating tubercles were seen, the largest being 3 mm. in diameter. The right was normal.

Coeliac Glands.—One coeliac gland contained several small caseating nodules.

Lumbar and Renal Glands.—These glands were enlarged, oedematous, and similar on section to the portal.

Iliac Glands.—The left was normal, the right contained two small caseating nodules.

Testicles.—Normal.

Alimentary Tract.

Tongue, Pharynx, Tonsils.—Normal.

Retro-pharyngeal Glands.—The left contained a nodule 6 mm. in diameter, the right a single small caseating tubercle.

Parotideal Glands.—Each contained several caseating nodules.

Submaxillary Glands.—Normal.

Intestines.—In one Peyer's patch two millet-seed sized caseous tubercles were seen, in another there was a single tubercle.

Mesenteric Glands.—Nearly all the mesenteric glands contained one or two irregular caseating nodules in the cortex.

Ileo-Colic Glands.—Each contained one or two small caseating patches in the cortex.

Various Lymphatic Glands.

Preaural.—Each contained two caseating nodules, the larger the size of a hemp-seed.

Popliteal.—The left contained two similar nodules, the right was normal.

Pudic, Ischiatic, Gluteal.—Normal.

Microscopical Examination.

Emulsion of Left Prescapular Gland.—Tubercle bacilli numerous.

Emulsion of Portal Gland.—Tubercle bacilli numerous.

Tubercle from a Peyer's Patch.—Tubercle bacilli very numerous.

CALF 1309. Virus H 13. "A.D."

Subcutaneous inoculation of culture derived from a small (dysgonic) colony [No. 5] on a glycerin-serum plate sown from Guinea-pig 2491. This guinea-pig had been injected with the "Calf 301" strain of culture.

Date of Inoculation—November 12, 1907. [Age about five months.]

Dose—44.0 milligrammes.

Died—December 12, 1907. [30 days after inoculation.]

Clinical Notes.

The disease ran a rapid course and was similar to that frequently seen in calves inoculated with 50 mg. of a virulent virus.

On December 5 there was a firm prominent tumour at the seat of inoculation infiltrating the muscles and adherent to the skin and measuring 14 by 9 cm. The adjacent prescapular gland was much enlarged, measuring 11 cm. in length.

The respiration was laboured and much increased in frequency; the animal stood with head stretched out, and coughed frequently. The appetite was poor, but there was no very obvious loss of flesh.

During the following week the animal rapidly grew worse; the respirations became more frequent, the calf lost its appetite and became emaciated. It died on December 12.

Temperature.—On the 7th day the temperature rose to 40.3° C., and remained high [between 39.6° C. and

40.6° C.] until December 10, a period of 22 days. On December 11 the temperature fell 2.0° C. [to 38.4° C.], and the following day the calf was dead.

Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

		cwt.	qrs.	lbs.
November 12, 1907	1	2 4
December 12, 1907	1	1 4

Total loss of weight.—1 qr. 0 lbs.

Average rate of loss per week.—6.5 lbs.

POST-MORTEM EXAMINATION.

The carcass was emaciated.

Local Lesion.—In the subcutaneous tissues on the left side of the neck there was a lenticular mass of

juicy yellow caseo-necrotic substance measuring 14 by 7 cm., by 2.5 cm. in thickness; the mass was adherent to the skin and muscles, both of which were infiltrated to a slight extent; the muscles were indurated for a depth of about 1 cm. and beset with discrete caseous tubercles.

Left Prescapular Gland.—The left prescapular gland measured 8 by 5.5 by 3 cm., and showed on section about half the cortex dense yellow and caseo-necrotic; the rest of the cortex was indurated, congested, and beset with discrete caseous tubercles.

Right Prescapular Gland.—The right prescapular gland measured 4.6 by 1.5 by 0.8 cm., and showed in the cortex a number of greyish-white miliary tubercles with deeply congested margins.

Prepectoral Glands.—The left prepectoral glands were slightly enlarged, congested, and oedematous, and showed in the cortex scattered greyish-white tubercles up to a millet-seed in size.

The right prepectoral glands contained tubercles similar to those in the right prescapular.

Cervical Glands.—All the cervical glands contained tubercles similar to those in the peripheral lymphatic glands (vide infra).

Thorax.

Pleura.—The fringes along the margins of the ribs were slightly hypertrophied and deeply congested; no tubercles were visible.

Lungs.—The lungs were heavy weighing 7 lbs. 11 ozs.; almost the whole of the parenchyma was dark red firm and quite airless; the only crepitant lung tissue that remained was along the dorsal borders, and this was congested, emphysematous, and showed here and there consolidated lobules.

The tissue of the lungs was closely and evenly beset throughout with miliary grey translucent tubercles.

The condition of the lungs closely resembled that following an intravenous inoculation.

Thoracic Glands.—The dorsal mediastinal and bronchial glands were enlarged and weighed together 8 ozs.; on section the cortices were composed almost throughout of firm greyish tissue containing caseous foci and here and there a caseous network; the medullary portions of the glands were deeply congested.

Heart.—The heart was a little enlarged and flabby, and showed numerous petechial haemorrhages under the pericardium; on the right ventricle a grey miliary tubercle was seen; the endocardium of the right side of the heart showed a number of small greyish-white tubercles; none was seen on the left side.

Larynx and Trachea.—Normal.

Abdomen.

Omentum and Peritoneum.—On the ventral surface of the omentum there was a number of small tubercles, one or two caseating.

The parietal peritoneum was normal.

Spleen.—The spleen was flabby and not enlarged; on section the pulp was soft, and showed on close inspection fairly numerous grey tubercles, the largest the size of a pin's head.

Liver.—The liver had a bright red colour, and was mottled or speckled with yellow foci (parenchymatous degeneration of the lobuli). Under the capsule a few small grey tubercles were seen; similar tubercles were sparsely scattered throughout the substance.

Portal Glands.—The portal glands were enlarged and very oedematous; they showed on section firm greyish patches continuous around the margins of the cortex containing scattered greyish-white foci.

Gall-bladder.—There was one minute tubercle under the mucous membrane of the gall-bladder.

Kidneys.—In the cortex of each kidney, on the surface as well as in the depth, there were scattered greyish-white tubercles, the largest a millimetre in diameter.

Suprarenal Bodies.—In the cortex of each a few minute grey tubercles were seen.

Alimentary Tract.

Pharynx.—In the corrugated membrane of the vault of the pharynx there were two or three small tubercles.

Tongue and Tonsils.—Normal.

Intestines.—The mucous membrane of the small intestine was congested; the Peyer's patches contained scattered soft yellow foci and an occasional grey tubercle.

The mucous membrane of the large intestine was congested; no definite tubercles were seen.

Testicles.—Normal.

Various Lymphatic Glands.

The Peripheral Lymphatic Glands, the Coeliac, Gastric, Mesenteric and Colic Glands, the Lumbar, Iliac, and Renal Glands, and the Retro-pharyngeal, Submaxillary, and Parotideal Glands all contained numerous discrete grey or greyish-white tubercles, which varied in size from a mere point to that of a millet seed; in many of the glands the tubercles were deeply congested around the margins.

The Ischiatic Glands alone were apparently normal.

Microscopical Examination.

Lung (smear from).—Short tubercle bacilli, moderately numerous, in cells.

Suprarenal (tubercle from).—One tubercle bacillus seen.

Spleen (smear from pulp).—One tubercle bacillus seen.

Intestine (tubercle from a Peyer's patch).—Tubercle bacilli numerous.

Intestine (soft focus from a Peyer's patch).—No tubercle bacilli.

CALF 1337. Virus H 13. "A.D."

Subcutaneous inoculation of culture derived from a single colony [No. 7] isolated on a glycerin-serum plate sown from the omentum of Guinea-pig 2605 (from Guinea-pig 2491, "Calf 301" strain).

Dose—59.0 milligrammes.

Date of Inoculation—January 17, 1908. [Age about 14 weeks.]

Killed when in good health—April 2, 1908. [76 days after inoculation.]

Clinical Notes.

The calf remained perfectly well during the experiment.

Temperature.—On the seventh day after inoculation the temperature rose to 40.0° C. and reached a

maximum (40.8° C.) on the 11th day; it remained high for ten days; on the 18th day the temperature was again normal, and it remained normal subsequently.

Tuberculin Test.—March 4, 1908. [47 days after inoculation.] Dose, 4.0 cc. of avian tuberculin. No reaction? Rise of temperature, 0.5° C.

Weights.				cwt. qrs. lbs.		
January 17, 1908	...	...	...	0	3	3
April 2, 1908	...	...	...	1	1	23
Total gain of weight.—2 qrs. 0 lbs.						
Average rate of gain per week.—5 lbs.						

POST-MORTEM EXAMINATION.

The carcass was in good condition.

Local Lesion.—At the site of inoculation on the left side of the neck there was a rounded fluctuating swelling measuring 6 by 5 by 3.5 cm.; it was composed of yellow caseo-purulent substance surrounded by a fibrous capsule.

Left Prescapular Gland.—The left prescapular gland measured 5.5 by 2.5 by 1.5 cm.; on section at one extremity there was a group of three dense caseo-calcareous nodules, the largest the size of a pea; at the other there was an irregular caseo-calcareous nodule, 1 cm. in diameter.

Right Prescapular Gland.—The right prescapular gland measured 4.5 by 2 by 1 cm. and was normal on section.

Cervical Glands.—On the left side a gland in the middle of the neck was slightly enlarged and the cortex was beset with yellow caseo-calcareous miliary tubercles, in places confluent. Other cervical glands were normal.

Thorax.

Lungs, Heart.—Normal.

Thoracic Glands.—The left bronchial gland showed one minute greyish-white point. Other thoracic glands were normal.

Pleura and Peritoneum.—On the peritoneum of the floor of the abdomen, and on the surface of the lung, there were several fibrous tags and a few small fibrous nodules.

Abdomen.

Liver, Spleen, Kidneys, Suprarenal Bodies.—Normal.

Portal, Coeliac, Renal, Lumbar, and Iliac Glands.—Normal.

Testicles.—Normal.

Alimentary Tract.

Tongue, Pharynx, Tonsils, Submaxillary and Retro-pharyngeal Glands.—Normal.

Intestines and Mesenteric Glands.—Normal.

Various Lymphatic Glands.

Precrural, Popliteal, Gluteal, Ischiatic, Axillary, Pudic.—Normal.

Microscopical Examination.

Emulsion of Prescapular Gland.—Tubercle bacilli moderately numerous.

CALF 1343. Virus H 13. "A.D."

Subcutaneous inoculation of culture derived from a single colony [No. 6] isolated on a glycerin-serum plate sown from the omentum of Guinea-pig 2605 (from Guinea-pig 2491, "Calf 301" strain).

Dose—78.0 milligrammes.

Date of Inoculation—January 16, 1908. [Age about 14 weeks.]

Killed when in good health—April 9, 1908. [84 days after inoculation.]

Clinical Notes.

The calf remained well during the experiment.

Temperature.

On the 8th day after inoculation the temperature rose to 40.0° C., and reached 40.3° C. on the 12th day; it then slowly fell, was normal on the 23rd day, and remained normal subsequently.

Tuberculin Test.

March 4, 1908. [48 days after inoculation.]

Dose—8.0 cc. of Leishmann's Tuberculin.

No reaction(?). Rise of temperature=0.6° C.

Weights.

				cwt. qrs. lbs.		
January 16, 1908	...	...	...	1	0	19
April 9, 1908	...	...	...	1	2	17
Total gain of weight.—1 qr. 26 lbs.						
Average rate of gain per week.—4.5 lbs.						

POST-MORTEM EXAMINATION.

The carcass was in good condition.

Local Lesion.—At the seat of inoculation there was a prominent circumscribed fluctuating swelling measuring 9 by 7 by 5 cm. On section, it was a cyst containing light brownish turbid fluid and caseo-purulent masses; the wall was of dense white fibrous tissue lined internally with granulation tissue, and the cavity was crossed by stout fibrous trabeculae.

Left Prescapular Gland.—The left prescapular gland measured 5 by 2.5 by 1.7 cm. and showed in the cortex five dense caseo-calcareous masses, the largest 1.5 cm. in greatest diameter.

Right Prescapular Gland.—The right prescapular

gland measured 4.2 by 1.8 by 1 cm., and was normal on section.

Pectoral, Cervical, and Axillary Glands.—Normal.

Thorax.

Pleura, Heart.—Normal.

Lungs.—The lungs were perfectly normal in general appearance. One pinhead-sized reddish-grey tubercle was seen just under the pleura of the right caudal lobe; otherwise the lungs were normal.

Thoracic Glands.—The bronchial and mediastinal glands were normal in size. The left bronchial gland showed on section one greyish-white focus which was not gritty. The other glands were normal.

Abdomen.

Omentum and Peritoneum; Spleen, Liver, Kidneys and Suprarenal bodies.—Normal.

Portal, Coeliac, Renal, Lumbar, and Iliac Glands.—Normal.

Testicles.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Retro-pharyngeal, Submaxillary, and Parotideal Glands.—Normal.

Intestines and Mesenteric Glands.—Normal.

Various Lymphatic Glands.

Precrural, Popliteal, Gluteal, Ischiatic, Pudic.—Normal.

Microscopical Examination.

Emulsion of Left Prescapular Gland.—Tubercle bacilli numerous.

CALF 1191. Virus H 49. "T.C."

Subcutaneous inoculation of culture derived directly from the human mesenteric glands (Blythwood strain).

Dose—50.0 milligrammes.

Date of Inoculation—February 26, 1907. [Age about 4½ months.]

Killed when in good health—May 31, 1907. [94 days after inoculation.]

Clinical Notes.

A fortnight after the inoculation on the left side of the neck there was an elongated firm local swelling, thick above and tapered below, extending into the dewlap and measuring 20 by 8 cm. The left prescapular gland was moderately enlarged, measuring 10 cm. in length.

The tumour and gland afterwards diminished considerably in size. On April 19, 52 days after inoculation, the former measured 14 by 7 cm. and the latter was 7 cm. in length.

The tumour subsequently became soft and fluctuating, and eventually opened and discharged caseopurulent matter.

The general condition and health of the calf remained good during the experiment.

Temperature.—On the 11th day the temperature rose suddenly to 40.7° C. It returned to the normal on the 19th day, and remained normal until the close of the experiment.

Tuberculin Test.—May 9, 1907. [72 days after inoculation.] Reacted. Rise of temperature, 1.8° C.

Weights.

			cwt.	qrs.	lbs.
February 26, 1907	...	...	1	3	8
May 31, 1907	...	...	2	1	21

Total gain of weight during experiment.—2 qrs. 13 lbs.

Average rate of gain per week.—5.1 lbs.

POST-MORTEM EXAMINATION.

Carcass in good condition.

Local Lesion.—In the subcutaneous tissues on the left side of the neck there was an oval tumour measuring 13 by 6.5 by 3 cm.; on section it was found to be composed of cysts or cavities of various sizes filled with creamy caseo-pus and surrounded by dense white fibrous tissue; the cysts were lined internally with granulation tissue in which numerous calcareous grains could be detected. The skin over the tumour was much thickened, measuring 1.5 cm. in greatest thickness.

Left Prescapular Gland.—The left prescapular gland measured 6.5 by 4 by 2 cm. On section it showed five caseo-calcareous nodules varying in diameter from 1 to 2 cm.; some of the nodules were partially softened, others contained small islets of translucent fibroid tissue.

Right Prescapular Gland.—Measured 4.5 by 2.3 by 1 cm. Normal.

Prepectoral and Axillary Glands.—Normal.

Thorax.

Pleura, Lungs, Heart, Thoracic Glands.—Normal.

Abdomen.

Peritoneum, Liver, Spleen, Kidneys, Suprarenals.—Normal.

Portal, Lumbar, Iliac, and Renal Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Submaxillary, Hyoid, Retro-Pharyngeal, and Parotid Glands.—Normal.

Intestines and Mesenteric Glands.—Normal.

Genito-Urinary System.

Testes.—Normal.

Various Lymphatic Glands.

Precurral, Popliteal, Gluteal, Ischiatic, Pudic.—Normal.

Microscopical Examination.

Emulsion of Prescapular Gland.—Tubercle bacilli fairly numerous.

Animal Inoculated.

Rabbit 1318 was inoculated with an emulsion made from the prescapular gland. It showed a local lesion only when killed after 129 days.

CALF 1193. Virus H 49. "T.C."

Subcutaneous inoculation of culture derived directly from the human mesenteric glands (Blythwood strain).

Dose—100.0 milligrammes.

Date of Inoculation—February 26, 1907. [Age about 4½ months.]

Killed when in good health—June 5, 1907. [99 days after inoculation.]

Clinical Notes.

A prominent tumour developed at the seat of inoculation on the left side of the neck. On the 16th day it was firm, and measured 12 by 8 cm. The left

prescapular gland was 9 cm. in length. The calf was well.

On the 52nd day the tumour measured 10 by 6 cm. and showed a prominent rounded fluctuating swelling 5 cm. in diameter at the upper part. The prescapular

gland was now 7 cm. in length. The calf was in good condition.

Subsequently the tumour opened and discharged, afterwards diminishing greatly in size.

The calf was killed on the 99th day, when quite well.

Temperature.—The temperature rose on the 11th day and reached 39·8° C. on the 13th day, and then quickly fell to normal. Subsequently it was approximately normal, but somewhat irregular, the maximum range of variation during 12 weeks being 1·4° C. (37·9–39·3° C.).

Tuberculin Test.—May 9, 1907. [72 days after inoculation.] Slight reaction. Rise of temperature, 0·8° C.

Weights.

			cwt.	qrs.	lbs.
February 26, 1907	...	...	1	3	9
June 5, 1907	...	...	2	2	7

Total gain of weight.—2 qrs. 26 lbs.

Average rate of gain per week.—5·8 lbs.

POST-MORTEM EXAMINATION.

Carcass in good condition.

Local Lesion.—The lesion at the seat of inoculation on the left side of the neck consisted of thickened skin and a thin patch (in the subcutaneous tissues) of fibrous tissue, about 5 cm. in greatest diameter; the latter was beset with soft caseo-calcareous nodules with translucent fibrous walls, the largest the size of a hemp seed; the thickened skin towards the lower part showed a healed sinus.

Left Prescapular Gland.—The left prescapular gland

measured 6 by 3 by 2 cm., and on section showed about two-thirds of its substance replaced by three large nodules with caseo-purulent centres and brownish translucent fibroid margins closely beset with calcareous grains.

Right Prescapular Gland.—The right prescapular gland measured 4 by 2 by 1 cm., and was normal on section.

Prepectoral and Axillary Glands.—Normal.

Thorax.

Pleura, Lungs, Thoracic Glands, Heart.—Normal.

Abdomen.

Omentum and Peritoneum, Liver, Portal Glands, Spleen, Kidneys, Suprarenals; Renal, Lumbar, and Iliac Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Tonsils; Glands of the Neck and Throat; Intestines and Mesenteric Glands.—Normal.

Testes.—Normal.

Various Lymphatic Glands.

Preaural and Popliteal, Gluteal and Ischiatic, Pudic.—Normal.

CALF 1213. Virus H 49. "T.C."

Subcutaneous inoculation of culture derived from the human mesenteric glands (Royalcot strain).

Dose—50·0 milligrammes.

Date of Inoculation—April 20, 1907. [Age about 16 weeks.]

Killed when in fair health—July 9, 1907. [80 days after inoculation.]

Clinical Notes.

A large tumour developed at the seat of inoculation on the left side of the neck; 24 days after inoculation the tumour measured 17 by 9 cm. It was firm and extended into the dewlap, and the skin over the centre showed a fissure discharging serum. The left prescapular gland was much enlarged, measuring 10 cm. in length.

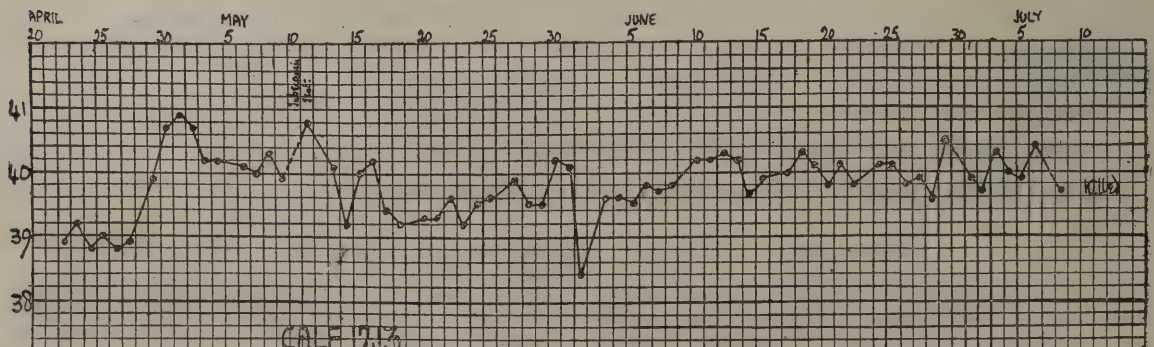
During the fourth week the calf was off its food, and lay on the ground more frequently than during the earlier part of the experiment. The respiration

was not increased, and there was no apparent loss in flesh.

Subsequently the respiration became definitely increased and the calf began to look thin.

Eighty days after inoculation the tumour was soft and fluctuating, partly detached from the muscles, and very pendulous, hanging below the dewlap. The fissure noticed in the overlying skin had closed up. The calf was fairly well but somewhat thin; the respiration was much increased in frequency. On this day it was killed.

Temperature.



Tuberculin Test.—May 9, 1907. [19 days after inoculation.] Reacted. Rise of temperature, 1.2° C.

Weights.

			cwt.	qrs.	lbs.
April 20, 1907 ...	...	...	1	1	16
July 9, 1907 ...	...	...	1	2	19
<i>Total gain of weight.</i> —1 qr. 3 lbs.					
<i>Average rate of gain per week.</i> —2.7 lbs.					

POST-MORTEM EXAMINATION.

Carcass in fair condition.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a very large pendulous fluctuating tumour, which measured 22 by 13 by 11 cm. and weighed with attached skin and muscles 1,278 grms.; on section the greater part of the tumour was a cyst filled with thin curdy caseo-pus and irregular caseo-necrotic masses, most of which were attached to the wall of the cavity; the cavity was surrounded by fibrous tissue lined internally with granulation tissue very gritty to the touch; short thick fibrous trabeculae projected into the cavity. The skin was thickened and beset with caseo-calcareous tubercles; the muscles under the cyst were very fibroid and infiltrated with calcareo-caseous tubercles. The lower part of the tumour tapered, and was composed of dense caseous substance surrounded by fibroid tissue infiltrated with calcareo-caseous streaks and foci.

Left Prescapular Gland.—The left prescapular gland weighed 135 grms. and measured 8 by 5.5 by 5 cm.; on section it was composed nearly throughout of dense pinkish-yellow caseous substance gritty only around the peripheral parts; the rest of the gland was beset with calcareo-caseous tubercles.

Right Prescapular Gland.—The right prescapular gland measured 4.5 by 2.2 by 1.2 cm. and showed on section two calcareo-caseous tubercles.

Left Prepectoral Glands.—The rounded gland, 1 cm. in diameter, showed three-quarters of its substance caseo-calcareous and in the rest discrete tubercles.

The kidney-shaped gland contained numerous minute calcareous foci.

Another deeper gland had three or four calcareous miliary tubercles in the cortex.

Right Prepectoral Glands.—Normal.

Cervical Glands.—On the left side one of the lower cervical glands was the size of a thrush's egg, and was dense and caseous throughout and slightly gritty from calcification. Another near it was beset with minute yellow foci; a gland near the articulation of the jaw contained a calcareo-caseous tubercle.

Other cervical glands were normal.

Axillary Glands.—The left axillary gland contained one, the right two, calcareous tubercles.

Thorax.

Pleura.—The lymphatic fringes along the margins of some of the ribs were slightly hypertrophied and contained here and there a small fibrous nodule.

On the diaphragmatic pleura there were some pinkish villous growths around the margins of the tendon, and on the left side an eruption of grey granules; there were also two nodules, one small and loosely pedunculated, the other about 1 cm. in diameter and not pedunculated; both were fibrous and contained calcareous grains.

Lungs.—The lungs were voluminous, emphysematous, and did not collapse on opening the chest; they weighed 4,601 grammes. The surfaces of the small anterior lobes and the ventral surface of each caudal were thickly studded with raised pinkish-grey translucent nodules, varying in shape and size, the largest being about 8 mm. in greatest diameter. They were most numerous on the anterior lobes, particularly where the lobes were in contact, and became gradually less numerous towards the tips of the caudal lobes; on the dorsal surfaces of the caudal lobes there were similar nodules, sparsely scattered.

On section they were found to extend into the lung substance, the pleura passing over them, and to have calcareous centres.

The substance of the lung under the pleura showed numerous irregular greyish-red patches and grey tubercles some calcareous in the centre, and calcareous nodules up to a pea in size irregularly distributed throughout each lobule.

On section of the lung similar appearances were seen; the reddish grey patches occupied the whole or part of a lobule, and in the latter cases were diffuse in outline and were situated chiefly in the centre of the lobule around the bronchus; they contained scattered calcareous tubercles and sometimes a large calcareous nodule.

In the anterior lobes, particularly on the right side, there were larger areas of consolidation than in the caudal lobes.

The fringes around the margins of the lungs were hypertrophied and showed a nodule here and there.

Thoracic Glands.—The thoracic glands weighed 341 grammes, and were much enlarged; they were firm and on section beset with yellow calcareous tubercles which formed in places irregular calcareous patches; the bronchial glands were more severely affected than the mediastinal and in them there was less normal looking gland tissue than in the latter.

The ventral mediastinal glands each contained a caseo-calcareous nodule.

Heart.—Normal.

Abdomen.

There was a slight excess of fluid in the peritoneal cavity.

Omentum.—The lymphatic fringes on the ventral surface were slightly hypertrophied and there were about a dozen loosely pedunculated nodules with calcareous centres and fibrous margins, the largest the size of a barley grain.

Parietal Peritoneum.—There was an eruption of flattened grey nodules, varying in size, on the right side of the diaphragm.

Spleen.—The spleen weighed 284 grammes; it showed on the surface several flattened deep red firm growths containing calcareous foci, and numerous rounded projections caused by nodules in the substance, the capsule over which was deeply congested. On section the pulp contained numerous nodules, varying in diameter up to 5 mm., with grey translucent margins and calcareo-caseous centres.

Liver.—The liver showed on the surface a small number of flat grey growths, loosely attached to the capsule and lying in shallow depressions in the liver substance; the largest measured 1 cm. in diameter and all contained yellow gritty foci; in the substance of the liver under the capsule fairly numerous evenly distributed grey tubercles with calcareous centres, the largest 2 mm. in diameter, were seen; on section similar tubercles were evenly distributed in the depth.

Gall-bladder.—Normal.

Portal Glands.—The portal glands were slightly enlarged and beset with yellow calcareo-caseous tubercles.

Kidneys.—In the cortex of each kidney on the surface as well as on section were fairly numerous nodules varying in size from a pin's head to that of a barley grain; the smaller ones were grey and translucent, the larger ones had yellow calcareous centres; many of the latter projected slightly from the surface and extended in a radial manner deeply into the cortex. There were besides many pale patches on the surface which on section were seen to be the bases of wedge-shaped areas which extended into the cortex.

Suprarenal Bodies.—Each showed in the cortex a hempseed-sized nodule with a grey margin and a calcareo-caseous centre, and several miliary tubercles.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Intestines, Small.—The mucous membrane of the ileum showed half-a-dozen ulcers with raised congested margins, slightly thickened base and caseous floor.

Intestines, Large.—In the caecum and large intestine there were three or four similar ulcers.

Mesenteric Glands.—The mesenteric glands contained scattered calcareous nodules and tubercles.

Gastric and Colic Glands.—These glands contained discrete calcareous tubercles.

Genito-Urinary Tract.

Testicles.—Normal.

Eyes.—Normal.

Various Lymphatic Glands.

Each Submaxillary, Parotideal, and Retro-pharyngeal Gland contained a few calcareo-caseous tubercles.

Coeliac Glands.—One was slightly enlarged and contained calcareous nodules with translucent fibrous margins confluent in places; others, not enlarged, showed discrete tubercles and nodules.

The Lumbar and Renal Glands were rather closely beset with discrete calcareo-caseous military tubercles; there were also a few larger nodules with calcareous centres.

The Precurral, Popliteal, and Iliac Glands contained scattered calcareo-caseous nodules, mostly about 2 mm., but several as much as 3 mm. in diameter.

The Gluteal and Ischiatic Glands were normal.

A Haemo-lymph Gland near a gluteal gland contained a millet-seed sized calcareous tubercle.

Microscopical Examination.

Emulsion of Prescapular Gland.—Tubercle bacilli fairly numerous.

Emulsion of Mediastinal Gland.—Tubercle bacilli scanty.

Animals Inoculated.

Calf 1263 was inoculated subcutaneously with an emulsion made from the left prescapular gland.

Two Rabbits, 1378–1379, were inoculated subcutaneously with the same emulsion. (Died of G.T. in 52 and 78 days.)

Two, Nos. 1376–1377, were inoculated subcutaneously with an emulsion made from the mediastinal gland. (Died of G.T. in 122 and 86 days.)

CALF 1263. Virus H. 49. "T.C."

Subcutaneous inoculation of an emulsion of the left prescapular gland from Calf 1213.

Dose—10·0 cc. of the emulsion, containing fairly numerous tubercle bacilli.

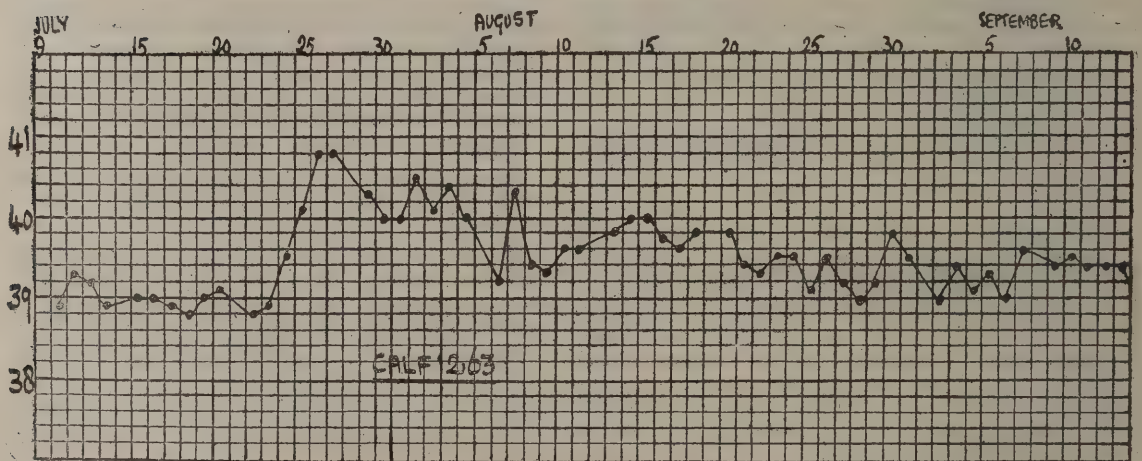
Date of Inoculation—July 9th, 1907. [Age about 17 weeks.]

Killed when in good health—October 8th, 1907. [91 days after inoculation.]

Clinical Notes.

The Calf remained in good health during the whole period of the experiment.

Temperature. (Chart to Sept. 13.)



From Sept. 13 to Oct. 8 the temperature was a little above the normal, and varied only within narrow limits (maximum 39·4° C., minimum 39·0° C.).

Tuberculin Test.—The calf was not tested subsequent to inoculation.

POST-MORTEM EXAMINATION.

The carcass was in good condition.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a firm, prominent, well-defined tumour, which when removed measured 11 by 8 by 5·5 cm., and weighed with skin and attached muscles 14 ozs.

On section it was composed of three layers, a middle one of dense yellow homogeneous caseated

Weights.

			cwt.	qrs.	lbs.
July 9, 1907	...	...	1	2	3
October 8, 1907	...	...	2	0	3
Total gain of weight.—2 qrs. 0 lbs.					
Average rate of gain per week.—4·3 lbs.					

tissue 1.5 cm. in greatest thickness, an outer one of greatly thickened skin beset with caseo-calcareous tubercles, and an inner one of fibroid muscular tissue infiltrated with irregular caseo-calcareous nodules and masses.

Left Prescapular Gland.—The left prescapular gland measured 10 by 5 by 4.5 cm., and weighed 6 ozs.; on section it was composed throughout of dense yellow caseous substance slightly gritty from calcification; the capsule was thickened.

Right Prescapular Gland.—The right prescapular gland measured 6 by 2 by 1 cm. and was normal on section.

Pectoral Glands.—On the left side one round gland measured 1.5 cm. in diameter and contained a caseo-calcareous nodule 8 mm. in greatest diameter; another was normal.

Those on the right side were normal.

Cervical Glands.—One near the angle of the jaw on the left side showed part of the cortex firm and infiltrated with caseo-calcareous points. A small gland in the middle of the neck on the right side contained a small calcareous tubercle.

Other cervical glands were normal.

Thorax.

Pleura.—The fringes along the margins of the ribs were hypertrophied in places; there were no nodules.

On the pleural surface of the diaphragm there was a loosely attached haemorrhagic nodule, the size of a split pea, with a caseo-calcareous centre.

Lungs.—The lungs were crepitant and collapsed normally; they showed on the surface a number of tuberculous growths similar to those on the liver, but containing caseo-calcareous patches, and under the pleura a moderate number of nodules; on section nodules, not in very large numbers, were found evenly distributed throughout the parenchyma; they varied much in size, the largest measuring 1 cm., the smallest about 1 mm. in diameter; the smaller ones were fibrous with calcareous centres, the larger were caseo-calcareous with fibrous margins; there were no patches of consolidation and no adhesions to the chest wall.

Thoracic Glands.—The bronchial and mediastinal glands were enlarged, weighing together 10 ozs.; on section they were dense and calcareo-caseous practically throughout, with the exception of one or two small glands which contained discrete nodules.

Heart and Pericardium.—Normal.

Abdomen.

Omentum and Peritoneum.—On the ventral surface of the omentum there were two small fibrous nodules, one with a calcareous centre.

On the peritoneal surface of the diaphragm there were about a dozen flattened translucent fibroid nodules, some calcareous in the centre.

Spleen.—The spleen was not enlarged and was normal on the surface; on section the pulp contained scattered nodules with yellow calcareous centres and fibrous margins, the largest 4 mm. in diameter. Twenty-seven were counted on one cut surface after longitudinal section.

Liver.—On the surface there were half a dozen slightly raised flattened fibroid growths, the largest

1 cm. in diameter, containing yellow calcareous foci; they were lobular in outline and extended only a short distance into the substance of the liver; under the capsule scattered nodules, some projecting, were seen; on section, nodules similar to those in the spleen were somewhat sparsely scattered throughout the substance.

Portal Glands.—Three were enlarged and closely beset with irregular yellow caseo-calcareous nodules, in places confluent, the largest 5 mm. in diameter; the rest were normal.

Kidneys.—The right kidney showed on the surface five and the left three greyish yellow nodules, the largest 6 mm. in diameter, some of which projected; on section they had grey fibrous margins and calcareo-caseous centres; several were lobular in outline as if composed of a number of smaller nodules, and some were much elongated radially, penetrating in a few cases the whole thickness of the cortex; in the depth of the cortex a few scattered nodules were seen.

Suprarenal Bodies.—Normal.

Lumbar and Coeliac Glands.—Two lumbar glands and one coeliac were enlarged, and on section resembled the portal glands.

Iliac Glands.—Normal.

Testicles.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Retro-pharyngeal, Submaxillary and Hyoid Glands.—Normal.

Parotideal Glands.—In the cortex of the left parotideal gland there was a hempseed sized caseo-calcareous nodule. The right was normal.

Intestines.—Normal.

Mesenteric Glands.—One at the posterior end of the mesentery contained a caseo-calcareous mass 1.7 cm. in greatest diameter; another a little anterior to the latter contained a nodule 5 mm. in diameter.

Ileo-colic Glands.—Normal.

Various Lymphatic Glands.

Preaural, Popliteal, Gluteal, Ischiatic, Pudic.—Normal.

Microscopical Examination.

<i>Emulsion of Prescapular Gland.</i>	} A few tubercle bacilli were seen in each, the bacilli were all very short.
<i>Emulsion of Portal Gland</i>	
<i>Emulsion of Thoracic Gland.</i>	

Animals Inoculated.

One rabbit, No. 1536, was inoculated subcutaneously with the emulsion of the left prescapular gland. (Died in 232 days of chronic progressive tuberculosis.)

Another, No. 1537, was inoculated subcutaneously with the emulsion of the portal gland. (Died prematurely.)

CALF 1347. Virus H 49. "T.C."

Subcutaneous inoculation of culture derived from the mediastinal gland of Calf 1263.

Dose—50.0 milligrammes.

Date of Inoculation—December 30, 1907. [Age about 11 weeks.]

Killed when ill—February 20, 1908. [52 days after inoculation.]

Clinical Notes.

A very large tumour developed at the seat of inoculation, which eventually ulcerated.

The calf gradually became ill and thin, and the respiration quickened; weakness and emaciation continued, and when killed on the 52nd day, the animal could not have lived more than a few days longer.

Temperature.—The temperature rose to 40.0° C. three days after inoculation, and reached a maximum (40.5° C.) on the ninth day. Subsequently the temperature was raised and irregular (maximum 40.0° C., minimum 38.2° C.) until the calf was killed.

Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

			qrs.	lbs.
December 30, 1907 ...	...	...	3	9
February 20, 1908 ...	...	...	3	9

POST-MORTEM EXAMINATION.

The carcass was emaciated.

Local Lesion.—At the seat of inoculation there was a very large firm prominent tumour extending down in front of the shoulder into the dewlap; it measured 15 by 12 by 7 cm. and weighed 2 lb. 6 ozs.

On section it was composed of an outer layer of pinkish yellow caseo-necrotic substance 2.5 cm. in greatest thickness and an internal layer (3 cm.) of fibroid muscular tissue very closely beset with caseous coalescing nodules. The skin over the greater part of the tumour was necrosed and ulcerating.

Left Prescapular Gland.—The left prescapular gland measured 9 by 5.5 by 5 cm. and weighed 8 ozs. It was adherent to the local lesion which partly surrounded it. On section, it was dense and caseous throughout.

Right Prescapular Gland.—The right prescapular gland measured 3.5 by 1.8 by 1 cm. and contained several firm caseous nodules.

Prepectoral Glands.—On the left side one was very large, measuring 3.5 cm. in greatest diameter, and showed the major part of the cortex grey and beset with caseous foci; two other small glands showed small caseous tubercles.

Cervical Glands.—All the cervical glands were enlarged; some contained discrete caseous nodules up to 3 mm. in diameter, others showed part of the cortex grey and infiltrated with caseous foci or a caseous network.

Left Axillary Gland.—The left axillary gland was very large and oedematous, and showed numerous minute greyish-white points in the cortex.

Thorax.

Pleura.—On the costal pleura there were several lenticular caseous nodules, varying up to 8 mm.; in several places the lymphatic fringes were hypertrophied and beset with small grey tubercles.

There were similar nodules and tubercles on the pleural surface of the diaphragm.

Lungs.—On the left side there were several recent adhesions to the chest wall, and the lobes on each side showed some slender adhesions to each other; the surfaces of the lungs (except where covered with thick pleura) were studded with raised grey nodules varying in size up to that of a hempseed; there were besides a

few flattened caseating nodules similar to those on the parietal pleura; on section the lung was found to be closely beset with nodules similar to those on the surface; they were grey and slightly caseous centrally; many lobules or parts of lobules were solid and caseating, especially in the caudal lobes.

The right anterior lobe was completely hepatised (old), and there were irregular patches in the other small lobes and in the ventral portions of the caudal lobes.

Thoracic Glands.—The dorsal mediastinal and bronchial glands were enlarged, and weighed 7 ozs.; their cortices were composed of translucent grey tissue infiltrated with a yellow caseous network.

Heart.—On the pleural surface of the pericardium there were several lenticular caseating nodules; in the auriculo-ventricular sulcus there was a large caseating nodule.

The endocardium of the right auricle showed a greyish-white miliary tubercle, and under the endocardium of the left ventricle there was a minute grey tubercle.

Trachea.—There was a quantity of mucus and mucopus in the trachea. The tracheal mucous membrane and the larynx were normal.

Abdomen.

Omentum and Peritoneum.—On the ventral surface of the omentum there were about half-a-dozen lenticular caseating nodules, the largest 5 mm. in diameter. The peritoneum was normal.

Spleen.—There were no tubercles on the surface; in the pulp there were fairly numerous completely caseous nodules ranging up to 2.5 mm. in diameter.

Liver.—On the surface there was a moderate number of flattened slightly raised nodules, with yellow caseous centres and grey margins, the largest 5 mm. in diameter; small yellow nodules were seen under the capsule in the substance. On section the substance contained evenly distributed caseous nodules, the largest the size of a hempseed; they were not very numerous, 12 only being counted in an area 5 cm. square.

Portal Glands.—The portal glands were enlarged, and their cortices composed of dense caseating nodular tuberculous masses.

Kidneys.—In the cortex of each kidney there was a moderate number of caseous nodules varying in size from a pin's head to that of a hempseed; the larger ones extended into the cortex in a wedge-shaped manner.

Suprarenal Bodies.—Each showed in the cortex several miliary caseous tubercles.

Lumbar Glands.—The lumbar glands were enlarged and contained more numerous nodules than the peripheral glands (*see below*).

Coeliac Glands.—The coeliac glands were enlarged, their cortices were grey and caseating.

Alimentary Tract.

Tongue, Pharynx, Palate.—Normal.

Tonsils.—One contained a caseous nodule 2 mm. in diameter.

Intestines.—All the Peyer's patches contained one or two yellow caseous nodules up to 2 mm., some ulcerated, and there were a few under the mucous membrane.

There were a few small nodules under the mucous membrane of the large intestine.

Mesenteric Glands.—The mesenteric glands all contained nodules and some grey caseating patches.

Ileo-colic Glands.—The ileo-colic glands showed the cortices extensively replaced by caseating patches.

Gastric and Colic Glands.—These glands contained small caseous tubercles.

Testicles.—Normal.

Peripheral Lymphatic Glands.

All the peripheral lymphatic glands contained moderately numerous yellow caseous nodules, varying in size up to three and sometimes rather more millimetres in diameter.

Eyes.—Normal.

CALF 1387. Virus H 49. "T.C."

Subcutaneous inoculation of culture derived from a single colony (No. 3) isolated from a glycerin-serum plate sown from the sternal gland of Guinea-pig 2918, which received a culture of the original material.

Dose—50·0 milligrammes.

Date of Inoculation—May 13, 1908 [Age about 11 weeks.]

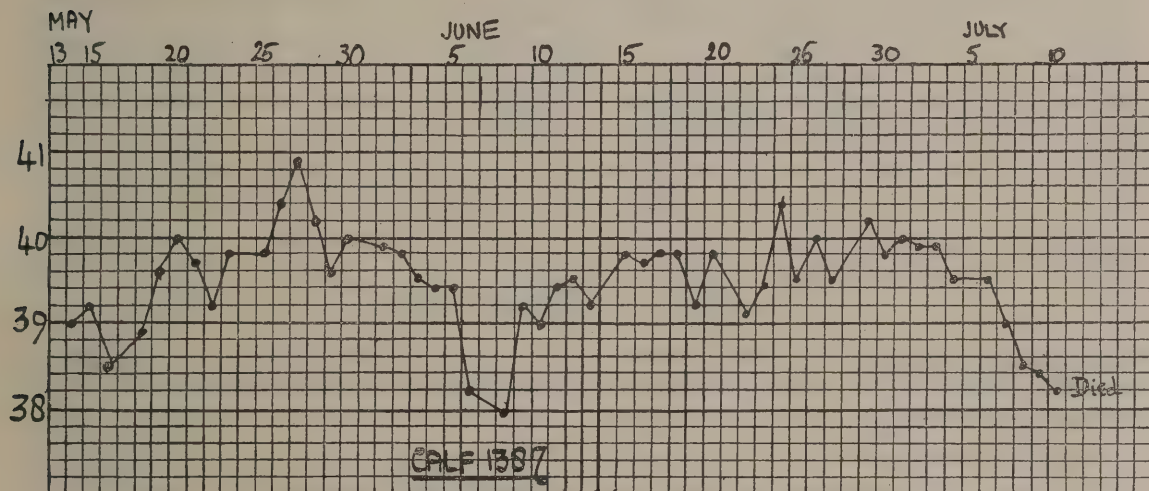
Died—July 10, 1908. [58 days after inoculation.]

Clinical Notes.

A large tumour developed at the seat of inoculation which afterwards ulcerated: the left prescapular gland became greatly enlarged. The calf gradually

became ill and thin and the respiration embarrassed; weakness and emaciation followed and the calf died on the 58th day after inoculation.

Temperature.



Weights.

	...	...	cwt.	qr.	lbs.
May 13, 1908	...	...	1	0	14
July 10, 1908	...	...	0	3	12

Total loss of weight.—1 qr. 2 lbs.

Average rate of loss per week.—3·8 lbs.

POST-MORTEM EXAMINATION.

The carcass was emaciated.

Local Lesion.—At the seat of inoculation there was a prominent swelling measuring 16 by 11 by 5 cm., the skin over which was necrosed and represented by a dry dark brown scab; the latter was fissured and partially detached, exposing foul smelling caseo-pus. On section the deeper parts of the tumour were composed of congested fibroid muscular tissue closely beset with caseating nodules and tracts some gritty from calcification.

Left Prescapular Gland.—The left prescapular gland weighed 7 ozs. and measured 10 by 5·5 by 5·4 cm.; on section it was composed practically throughout of dense pinkish-yellow caseous substance slightly gritty from calcification and beginning to break down in places under the capsule.

Right Prescapular Gland.—The right prescapular gland measured 4 by 2 by 0·8 cm. and contained three caseating nodules the largest the size of a hemp seed.

Prepectoral Glands.—Two on the left side showed early caseation of the cortex: two others a caseous tubercle or two.

Those on the right side each contained a few caseating nodules.

Cervical Glands.—One on the left side near the first rib was enlarged, the cortex was grey and showed discrete caseous tubercles; most of the other cervical glands contained one or two discrete caseous nodules.

Axillary Glands.—The cortex of the left axillary gland was firm and showed minute caseous foci.

The right axillary gland contained one caseous nodule.

Thorax.

There was a slight excess of fluid in the pleural cavities.

Pleura.—The costal and diaphragmatic pleurae showed a few congested flattened nodules and patches of congested vegetations.

Lungs.—The lungs filled the chest and weighed

5 lbs. 2 ozs. On the surface there were scattered congested caseating nodules up to 5 mm. in diameter; the anterior lobes, a small portion at the antero-ventral end of the left caudal lobe and almost the whole of the right caudal lobe were red and consolidated; both caudal lobes on section showed moderately numerous caseating nodules varying in size up to about 3 mm. congested around the margins and in places confluent; there were similar nodules in the anterior lobes but much less numerous; the consolidated tissue on section showed a greyish mottling (? early tuberculous infiltration); the trachea and many of the bronchi contained muco-pus.

The mucous membrane of the trachea and larynx was normal.

Thoracic Glands.—The bronchial and mediastinal glands were much enlarged, especially the long mediastinal gland, which measured 15 cm. in length; on section the cortices were composed of greyish fibroid tissue containing gritty caseous tubercles and irregular caseous patches.

Heart.—Normal.

Abdomen.

Omentum and Peritoneum.—On the ventral surface of the omentum there were sparsely scattered flattened congested nodules.

The parietal peritoneum was normal.

Liver.—The liver showed on the surface scattered flattened caseating growths, some loosely attached, others attached by a broad base, the largest about 1 cm. in diameter. On section the substance contained sparsely scattered grey tubercles with caseous centres the largest the size of a millet seed.

Portal Glands.—The portal glands were enlarged and the cortices filled with nodular caseating masses.

Spleen.—The spleen was not enlarged and contained moderately numerous grey nodules with caseous centres varying up to 3 mm. in diameter.

Kidneys.—On the surface of the left kidney there were twenty-eight caseous nodules varying in size up to that of a hemp-seed; some projected from the

surface, a few were elongated in a radial direction; a few caseous nodules were seen on section.

On the surface of the right kidney there were twenty-two caseous nodules and several were seen in the depth of the cortex.

Suprarenal Bodies.—Normal.

Coeliac Glands.—The coeliac glands were enlarged and composed practically throughout of greyish tissue surrounding yellow caseous nodules.

Lumbar and Renal Glands.—The lumbar and renal glands were beset with caseating nodules.

Alimentary Tract.

Tongue, Tonsils, and Pharynx.—Normal.

Small Intestines.—On the mucous surface three small ulcerated caseous nodules were seen.

Large Intestine.—Normal.

Mesenteric Glands.—All the mesenteric glands were affected, containing caseating nodules, the largest 1·5 cm. in diameter.

Ileo-colic and Colic Glands.—The ileo colic and several of the colic glands contained similar nodules.

Testicles.—Normal.

Various Lymphatic Glands.

The peripheral lymphatic glands contained a varying number of caseating nodules (up to 3 mm. in diameter), most numerous in the retro-pharyngeal and precrucial glands.

Microscopical Examination.

Emulsion of Prescapular Gland.—A few tubercle bacilli seen.

Emulsion of Mediastinal Gland.—A few tubercle bacilli seen.

Emulsion of Popliteal Gland.—A few tubercle bacilli seen.

CALF 1415. Virus H 49. "T.C."

Subcutaneous inoculation of culture derived from a single colony (No. 7) isolated from a glycerin-serum plate sown from Guinea-pig 2918. This guinea-pig was inoculated with the original strain of culture.

Dose—50·0 milligrammes.

Date of Inoculation—May 18, 1908. [Age about 13 weeks.]

Killed when in good health—August 28, 1908. [102 days after inoculation.]

Clinical Notes.

The calf remained in good health during the experiment.

Temperature.

There was a slight rise of temperature commencing on the tenth day and lasting ten days (maximum 40·2° C.). With this exception the temperature was perfectly normal during the experiment.

Tuberculin Test.

August 18, 1908. [92 days after inoculation.]
Dose, 2·0 cc. Reacted. Rise of temperature, 1·5° C.

Weights.

	cwt.	qr.	lbs.
May 18, 1908 ...	1	0	18
August 28, 1908 ...	1	1	25

Total gain of weight.—1 qr. 7 lbs.

Average rate of gain per week.—2·4 lbs.

POST-MORTEM EXAMINATION.

The carcass was in good condition.

Local Lesion.—On the left side of the neck there was a prominent circumscribed fluctuating tumour measuring 9 by 5·5 by 4 cm.; on section it contained a loose dense caseous sequestrum separated from a thick fibrous capsule by yellow pus.

Left Prescapular Gland.—The left prescapular gland measured 6 by 3 by 2·5 cm. and showed more than three quarters of its substance composed of dense caseous material slightly gritty from calcification.

Pectoral Glands.—On the left side one contained a fibro-calcareous nodule 5 mm. in diameter. The rest were normal.

Right Prescapular Gland.—The right prescapular gland measured 5 by 2·2 by 1 cm. and was normal on section.

Other glands and all the organs were examined and found normal.

Microscopical Examination.

Emulsion of Prescapular Gland.—A few beaded tubercle bacilli seen.

CALF 1413. Virus H 49. "T.C."

Subcutaneous inoculation of culture derived from a single colony (No. 17) isolated from a glycerin-serum plate sown from Guinea-pig 2918. This guinea-pig was inoculated with the original strain of culture.

Dose—50·0 milligrammes.

Date of Inoculation—May 18, 1908. [Age about 11 weeks.]

Killed when in good health—September 2, 1908. [107 days after inoculation.]

Clinical Notes.

The calf remained well during the experiment.

Temperature.

On the 10th day after inoculation the temperature rose from the normal sharply to 40·3° C. and then slowly fell; on the 17th day it was again normal (38·9° C.), and remained normal until the animal was killed.

Tuberculin Test.

August 18, 1908. [92 days after inoculation.]
Dose, 2·0 cc. Reacted. Rise of temperature, 2·1° C.

Weights.

			cwt.	qr.	lbs.
May 18, 1908	...	...	1	0	5
September 2, 1908	...	...	1	1	18

Total gain of weight.—1 qr. 13 lbs.

Average rate of gain per week.—2·7 lbs.

POST-MORTEM EXAMINATION.

The carcass was in good condition.

Local Lesion.—The lesion at the seat of inoculation on the left side of the neck consisted of a small subcutaneous mass of fibrous tissue containing scattered calcareous nodules, and a cyst 1 cm. in diameter filled with caseo-pus; the skin showed a funnel-shaped depression, the apical part of which was formed by scar tissue.

Left Prescapular Gland.—The left prescapular gland measured 7 by 4 by 3·5 cm. and was composed throughout of very dense pinkish yellow caseous substance, gritty from calcification; the capsule was much thickened, and was in places separated from the dense caseous substance by caseo-pus.

Right Prescapular Gland.—The right prescapular gland measured 4·8 by 1·5 by 0·8 cm. and was normal on section.

Prepectoral Glands.—One prepectoral gland on the left side contained a hempseed-sized caseo-calcareous nodule. Other prepectoral glands were normal.

Cervical Glands.—On the left side two contained each one caseous miliary tubercle; in another there were two pinhead-sized caseous tubercles, one gritty.

Thorax.

Pleura and Heart.—Normal.

Lungs.—The lungs were crepitant throughout; they showed under the pleura evenly distributed not very numerous nodules varying in size from a pin's head up to a little larger than that of a hemp seed; 78 were counted on the surface of the left lung. They were calcareous and had grey fibrous margins. Similar nodules were sparsely scattered throughout the substance of the lung.

Thoracic Glands.—The bronchial and mediastinal glands were a little enlarged; their cortices were closely beset with highly calcareous tubercles mainly discrete, but here and there aggregated together.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—The spleen was normal in size; the pulp contained scattered yellow calcareous tubercles ranging from 1·5 to 2·5 mm. in diameter; each had a grey fibrous capsule from which the calcareous centre easily shelled; three dozen were counted on the two cut surfaces after longitudinal section.

Liver.—In the substance of the liver under the capsule there were eight grey tubercles up to a millimetre in diameter all with calcareous centres; two similar tubercles were seen in the depth.

Portal Glands.—The portal glands were not enlarged. Each contained a few calcareous tubercles up to a millet seed in size.

Kidneys and Suprarenal Bodies.—Normal.

Renal Glands.—Between the kidneys there were four pigmented glands, each of which contained a few yellow calcareous foci.

Coeliac Glands.—One coeliac gland—not enlarged—contained discrete yellow calcareous miliary tubercles.

Lumbar and Iliac Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Tonsils.—Normal.

Retro-pharyngeal Glands.—The right contained two nodules each 2 mm. in diameter, one caseous the other calcareous.

Submaxillary Glands.—Normal.

Parotideal Glands.—The left showed a cavity rather more than 1 cm. in diameter filled with tenacious yellow pus.

Intestines.—Normal.

Mesenteric Glands.—The mesenteric glands contained two calcareous tubercles.

Ileo-colic Glands.—Two ileo-colic glands showed scattered calcareous tubercles.

Mammary Gland.—Normal.

Various Lymphatic Glands.

Precrural, Popliteal, Gluteal, Ischiatic, Pudic.—Normal.

Microscopical Examination.

Emulsion of Lung Tubercle.—Few tubercle bacilli.

Emulsion of Bronchial Gland.—Few tubercle bacilli.

Pus from Left Parotideal Gland.—No tubercle bacilli.

CALF 1501. Virus H 49. "T.C."

Subcutaneous inoculation of culture derived from Colony No. 17 isolated from a glycerin-serum plate sown from the sternal gland of Guinea-pig 2918.

Dose—48·0 milligrammes.

Date of Inoculation—November 12, 1908. [Age 7 weeks.]

Died—December 27, 1908. [45 days after inoculation.]

Clinical Notes.

The course of the disease was similar to that usually

seen after the inoculation of 50·0 mg. of a virulent virus.

Temperature.

On the day following the inoculation the temperature was 39.5° C.; it rose slowly and reached 41.0° C. on the 9th day. The temperature was raised during the remaining period of the experiment, averaging about 40.1° C.; on the day of death it dropped sharply from 39.8° C. to 38.1° C.

Weights.

			qrs.	lbs.
November 12, 1908	...	...	3	22
December 27, 1908	...	...	3	5

Total loss of weight.—17 lbs.

Average rate of loss per week.—2.6 lbs.

POST-MORTEM EXAMINATION.

The carcass was thin.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a prominent firm tumour measuring 11.5 by 8 by 4 cm. composed of pinkish caseo-necrotic substance infiltrating both the skin and the muscles.

Left Prescapular Gland.—The left prescapular gland measured 7.5 by 4.5 by 3.5 cm.; the cortex was composed of dense pinkish-yellow caseo-necrotic substance, in which opaque yellow calcareous foci and fine streaks were seen; a small portion of the medulla was composed of yellowish-white confluent caseous tubercles.

Right Prescapular Gland.—The right prescapular gland measured 4.5 by 2 by 0.6 cm. and contained in the cortex a moderate number of caseous tubercles varying from 1 to 2 mm. in diameter.

Left Prepectoral Glands.—The round gland measured 1.9 cm. in diameter and was composed throughout of firm greyish-red tissue beset with caseous foci; a second prepectoral gland showed confluent tubercles in its cortex and a few small discrete tubercles in the reddish medulla. A third showed in the cortex small patches of caseous tubercles and a few small yellowish-white discrete tubercles in the medulla.

Right Prepectoral Glands.—The right prepectoral glands contained a few small yellowish caseous tubercles and larger caseating nodules.

Left Cervical Glands.—The lower cervical gland on the left side contained numerous small discrete caseous tubercles some of which were becoming confluent. A mid-cervical gland was entirely composed of greyish-yellow necrotic substance. The left upper cervical gland showed in its cortex a moderate number of yellowish-white caseous tubercles varying from 1 to 3 mm. in diameter; each of the other cervical glands contained a few caseous tubercles.

Right Cervical Glands.—In each of the cervical glands on the right side there were a few tubercles the majority of which were a little more than 2 mm. in diameter.

Axillary Glands.—In the left axillary gland there were three yellowish nodules measuring rather more than 2 mm. in diameter and a moderate number of small discrete yellowish-white caseous tubercles in the cortex. The right contained four similar nodules.

Thorax.

Lungs.—The lungs were heavy weighing 4 lbs. 12 ozs.; the cephalic, right middle, and antero-ventral portions of the caudal lobes were dark-red firm and almost completely airless; the rest of the caudal lobes was congested and mottled with irregular patches of red hepatization; the lung parenchyma was closely and evenly beset with firm caseous nodules varying up to about 2.5 mm. in diameter; here and there throughout the lung they were aggregated together into groups in places forming irregular nodules.

Thoracic Glands.—The bronchial and dorsal mediastinal glands were enlarged, the long mediastinal measuring 13.5 by 3.5 by 2.5 cm.; they were firm and composed practically throughout of dense congested greyish-yellow caseating tissue showing here and there opaque yellow points probably of beginning calcification; in the medulla of some of the glands there were discrete caseous tubercles.

A ventral mediastinal gland on the left side measured

3 by 2.5 by 1 cm. and was composed practically throughout of firm reddish tissue infiltrated with a caseous network.

Heart.—Under the endocardium of the right auricle four small greyish-white tubercles were seen: the heart was otherwise normal.

Pleura.—The villous fringes on the pleural surface of the diaphragm were hypertrophied; there was one lenticular growth measuring 4 mm. in diameter, yellowish-white and caseous in the centre.

The fringes along the intercostal spaces were hypertrophied but no tubercles were seen.

Larynx.—The mucous membrane of the larynx showed four caseous tubercles with congested margins and ulcerated surface.

Trachea.—There were a few congested spots with caseous centres in the mucous membrane of the trachea.

Abdomen.

Omentum and Peritoneum.—On the surface of the omentum there were counted seventeen loosely attached flattened caseating growths, the largest measuring a little more than 6 mm. in diameter.

The peritoneum was normal.

Spleen.—The spleen was moderately closely beset with firm greyish-yellow nodules varying from 2 to nearly 3 mm. in diameter.

Liver.—The liver showed on the surface just beneath the capsule numerous evenly distributed yellowish tubercles varying from 1 to 2 mm. in diameter. On section similar tubercles were seen evenly distributed throughout its substance; besides the caseous tubercles there were many minute grey tubercles.

Portal Glands.—The portal glands were enlarged and slightly oedematous; their cortices were moderately closely beset with coalescing caseous tubercles, and there were a few discrete caseous tubercles in the medulla.

Coeliac Glands.—The coeliac glands were enlarged, their cortices contained caseous tubercles becoming confluent, and the medullae a few discrete tubercles measuring 1 mm. in diameter.

Kidneys.—On the surface of the right kidney twenty-one yellowish tubercles varying from 1 to 2 mm. in diameter were counted. Some of the tubercles had grey margins. Two caseous tubercles with grey margins were seen in the cortex on section.

On the surface of the left kidney nine tubercles similar to those in the right were counted and four were seen in the cortex on section.

Suprarenal Bodies.—Each suprarenal contained in the cortex one yellowish-white caseous tubercle measuring a little more than 1 mm. in diameter.

Renal Glands.—The right was moderately closely beset with yellowish-white coalescing caseous tubercles, the left showed caseous tubercles becoming confluent.

Lumbar Glands.—All the lumbar glands showed discrete whitish caseous nodules, in places aggregated together, measuring from 2 to 3 mm. in diameter.

Iliac Glands.—Each iliac gland contained about ten caseous nodules.

Alimentary Tract.

Tongue.—Under the mucous membrane at the base of the tongue there were a few small tubercles.

Pharynx.—In the mucous membrane at the vault of the pharynx there were a few caseous tubercles.

Tonsils.—The left tonsil contained four, the right five firm caseous nodules, the largest almost the size of a hemp-seed.

Parotideal Glands.—Each parotideal gland contained about twenty yellowish caseous nodules varying in size from 1 to 3 mm. in diameter.

The Submaxillary and Retro-pharyngeal Glands contained similar tubercles.

Intestines.—The walls of the small intestine were thin; every Peyer's patch contained soft yellowish-white tubercles varying from 1 to 2 mm. in diameter; they were moderately numerous in the long Peyer's patch in the ileum, and varied in number from two to

eight or nine in the smaller patches. A few similar tubercles were seen scattered about in the submucosa of the duodenum and the jejunum.

The lymphoid follicles in the large intestine were enlarged, and each showed a central depression but no sign of caseation.

Gastric Glands.—All the gastric glands were enlarged and contained confluent caseous tubercles.

Mesenteric Glands.—Some of the mesenteric glands were slightly enlarged; each showed in the cortex discrete caseous tubercles or caseating patches up to 5 mm. in diameter.

Ileo-colic Glands.—The ileo-colic glands were enlarged and showed in the cortex moderately numerous yellowish white tubercles becoming confluent.

Various Lymphatic Glands.

Precural Glands.—Both contained a moderate number of yellow caseous nodules, the majority

measuring 3 mm. in diameter and in places becoming confluent.

Popliteal Glands.—The popliteal glands were similar to the precural.

The Supramammary Gland contained three caseous nodules 3 mm. in diameter.

Gluteal Glands.—In the left there were five yellowish-white tubercles measuring rather more than 1 mm. in diameter; the right contained nine similar tubercles.

Ischiatic Glands.—The left contained one similar tubercle; the right was normal.

Brain.—Normal.

Microscopical Examination

Smear from a Tubercle in the Small Intestine.—Tubercle bacilli numerous.

CALF 1203. Virus H 60. "W.B."

Subcutaneous Inoculation of culture derived from the human bronchial gland, through G.P. 1825 (The strain had been nearly a year in artificial cultivation and was tested after growth on glycerin-media).

Dose—48.0 milligrammes.

Date of Inoculation—March 26, 1907. [Age 13 weeks.]

Killed when in good health—July 1, 1907. [97 days after inoculation.]

Clinical Notes.

A large tumour developed at the seat of inoculation on the left side of the neck; three weeks after inoculation it was firm and prominent, measuring 15 by 8 cm., and between 3 and 4 cm. thick. The left prescapular gland was 10 cm. in length; the left prepectoral gland was the size of a small walnut. The calf was in good condition.

The tumour subsequently became pendulous and cystic, and eventually (on June 30th) opened and discharged thick caseo-pus.

The calf remained in good health during the whole period of the experiment.

Temperature.

During the first three weeks after the inoculation the temperature was a little raised (maximum 39.8° C.). Subsequently it was approximately normal.

Tuberculin Test.

The Calf was not tested subsequent to inoculation.

Weights.

			wt.	qrs.	lbs.
March 26, 1907 ...	...	...	1	0	26
July 1, 1907 ...	...	...	2	0	15

Total gain of weight.—3 qrs. 17 lbs.

Average rate of gain per week.—7.2 lbs.

POST-MORTEM EXAMINATION.

Carcass in good condition.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a baggy partially collapsed oval cystic swelling, measuring 12 by 8 cm. in superficial area; on section the cyst was partially filled with thick tenacious caseo-pus, and was surrounded by a thick wall of fibrous tissue lined internally with granulation tissue beset with caseo-calcareous tubercles: the skin was adherent to the anterior wall of the cyst and was greatly thickened; it was pierced towards the upper extremity by a sinus the diameter of a crowquill, which communicated with the interior of the cavity and through which caseo-pus could be expressed.

Left Prescapular Gland.—The left prescapular gland

measured 8 by 4.5 by 3 cm., and showed on section two dense irregular caseous masses calcareous around the margins occupying rather more than half of the gland substance.

Right Prescapular Gland.—(4.3 by 2.2 by 1 cm.). Normal.

Left Prepectoral Glands.—The rounded gland was about the size of a thrush's egg and had about a third of its substance replaced by dense caseo-calcareous substance. The reniform gland was much enlarged and showed on section scattered calcareous foci.

Right Prepectoral Glands.—Normal.

Cervical Glands.—A lower cervical gland on the left side of the neck contained two or three calcareous tubercles. Other cervical glands were normal.

Thorax.

Pleura.—The parietal pleura was normal; on the diaphragmatic pleura there was one pin-head sized fibrous tubercle.

Lungs.—The lungs were perfectly normal in general appearance; on close inspection sparsely scattered grey tubercles, ranging up to 1 mm. in diameter, were seen under the pleura; twenty-four were counted on the surface of the left and there was about the same number on that of the right; similar tubercles were sparsely scattered throughout the substance of the lung; the larger tubercles had calcareous centres, the smaller ones were quite grey and translucent.

Larynx and Trachea.—Normal.

Thoracic Glands.—The bronchial and dorsal mediastinal glands were not enlarged; on section they were beset, though not very closely, with discrete calcareous tubercles which could be readily shelled out from normal-looking gland substance. The ventral mediastinal glands were normal.

Heart and Pericardium.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—The spleen, normal on the surface, showed on section altogether about fifty grey nodules with calcareous centres, ranging in size from a millet to a hemp seed.

Liver.—Normal.

Kidneys.—Normal.

Suprarenal Bodies.—Normal.

Portal Glands.—The portal glands, not enlarged, contained discrete calcareous tubercles similar to those in the thoracic glands, but not so numerous.

Coeliac Glands.—The coeliac glands were not enlarged; one showed a small group of calcareous tubercles; another contained one calcareous tubercle.

Renal, Lumbar, and Iliac Glands.—One lumbar gland contained two minute calcareous tubercles. The renal and iliac glands were normal.

Ilio-sacral Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Tonsils.—Normal.

Intestines.—Normal.

Mesenteric Glands.—In the cortex of one there was a minute calcareous tubercle.

Gastric, Ileo-colic and Colic Glands.—Normal.

Testicles.—Normal.

Various Lymphatic Glands.

Retro-pharyngeal Glands.—One contained a small group of calcareous grains; in the other there was a small calcareous tubercle.

Submaxillary, Parotideal, Mastoid, Axillary, Pre-crural, Popliteal, and Pudic Glands.—Normal.

Microscopical Examination.

Emulsion of Prescapular Gland.—Tubercle bacilli fairly numerous.

Emulsion of Bronchial Gland.—One tubercle bacillus seen.

Animals Inoculated.

One rabbit was inoculated with the bronchial gland emulsion, No. 1363, subcutaneously (died 111 days, G.T.).

Two rabbits were inoculated with the prescapular gland emulsion, Nos. 1364, 1365, both subcutaneously (the former died prematurely, the latter died of chronic G.T. in 138 days).

CALF 1481. Virus H 60. "W.B."

Subcutaneous inoculation of culture derived from a single colony (No. 1) isolated from a glycerin-serum plate sown from Guinea-pig 2489.

Dose—50.0 milligrammes.

Date of Inoculation—July 30, 1908. [Age about 18 weeks.]

Killed when in good health—November 3, 1908. [96 days after inoculation.]

Clinical Notes.

The calf remained well during the experiment.

Temperature.

On the 9th day after inoculation the temperature rose to 40.3° C. and continued high (about 40.0° C.) for 17 days. It then fell to the normal and remained normal subsequently.

Weights.

			cwt.	qrs.	lbs.
July 30, 1908	...	...	1	2	1
November 3, 1908	...	...	1	3	21
Total gain of weight.—1 qr. 20 lbs.					
Average rate of gain per week.—3.4 lbs.					

POST MORTEM EXAMINATION.

The carcass was in good condition.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a tumour measuring 9 by 6 by 5 cm. which on section was composed of fibrous tissue with a cavity in the centre filled with caseo-pus.

Left Prescapular Gland.—The left prescapular gland measured 6 by 3 by 2.5 cm. and contained one large fibro-caseo-calcareous mass and several smaller ones; they replaced about two-thirds of the gland tissue.

Right Prescapular Gland.—The right prescapular gland measured 5 by 2 by 1 cm. and was normal on section.

Pectoral, Axillary, and Cervical Glands.—Normal.

Thorax.

Lungs.—Under the pleura seven submiliary grey tubercles with minute calcareous centres were seen. A few tubercles were seen on section.

Thoracic Glands, Pleura, Heart.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Liver.—Under the capsule there were two grey tubercles each with a minute yellow centre; no tubercles were seen on section.

Spleen, Kidneys, and Suprarenal Bodies; Renal, Lumbar, Iliac, and Portal Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils; Submaxillary, Retro-pharyngeal, and Parotideal Glands; Intestines and Mesenteric Glands.—Normal.

Ileo-colic Glands.—One ileo-colic gland contained two or three calcareous grains.

Mammary Gland.—Normal.

Various Lymphatic Glands.

Pre-crural, Popliteal, Gluteal, Ischiatic, and Pudic.—Normal.

Microscopical Examination.

Focus from Liver.—No tubercle bacilli. A few thick bacilli and a few segmented bacilli stained blue.

CALF 1425. Virus H 60. "W.B."

Subcutaneous inoculation of culture derived from a single colony (No. 5) isolated from a glycerin-serum plate sown from Guinea-pig 2489.

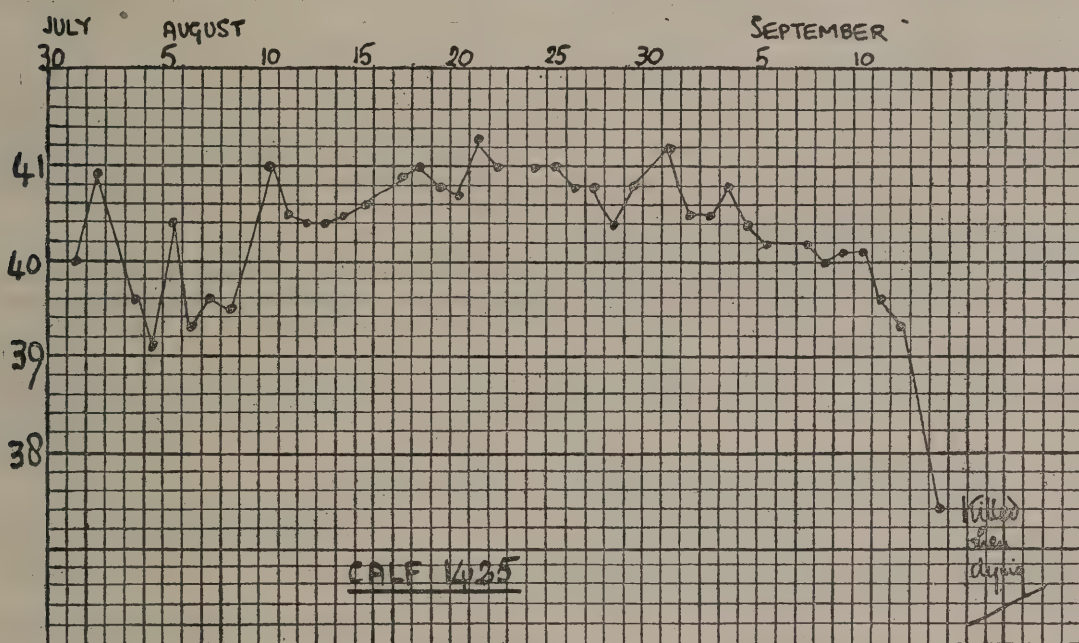
Dose—50·0 milligrammes.

Date of Inoculation—July 30, 1908. [Age about 19 weeks.]

Killed when dying—September 14, 1908. [46 days after inoculation.]

Clinical Notes.

The course of the disease was similar to that usually seen in calves inoculated with virulent viruses.

Temperature.*Weights.*

		cwt.	qrs.	lbs.
July 30, 1908	...	1	2	17
September 14, 1908	...	1	0	22

Total loss of weight.—1 qr. 23 lbs.

Average rate of loss per week.—7·7 lbs.

POST-MORTEM EXAMINATION.

The carcass was thin.

Local Lesion.—The tumour at the seat of inoculation on the left side of the neck was very large: the left prescapular gland was incorporated with it: the mass weighed 3 lbs. 15 ozs.; the tissues surrounding it were very oedematous.

The tumour alone was pear-shaped measuring 20·5 cm., by 14 cm. in its widest part, by 7 cm. On section the central part was composed of firm pink caseo-necrotic substance in two places commencing to break down; above it the skin was thickened and infiltrated right up to the surface with caseating areas; below it there was a mass of infiltrated muscle.

Left Prescapular Gland.—The left prescapular gland was very large measuring 10 by 6·5 by 5·5 cm. On section it was composed throughout of firm caseo-necrotic substance and showed two small crescent-shaped cavities containing fluid.

Right Prescapular Gland.—The right prescapular gland measured 4 by 2 by 1 cm. and contained four congested caseous tubercles up to 2 mm. in diameter.

Left Prepectoral Glands.—The rounded prepectoral gland was the size of a thrush's egg, and was caseating throughout. The kidney-shaped gland measured 4 by 3 cm. It was composed of glandular tissue thickly peppered with irregular whitish tubercles often confluent. A smaller gland adjacent to it was similar.

Right Prepectoral Glands.—One contained a single caseous tubercle, the others appeared normal.

Left Cervical Glands.—One mid-cervical gland was enlarged and in an early stage of caseation. Another contained caseous tubercles.

An upper cervical gland was enlarged and oedematous, and showed caseous tubercles in the cortex.

Right Cervical Glands.—A mid-cervical gland contained two millet-seed sized yellow tubercles with congested margins. An enlarged upper cervical gland contained two similar tubercles.

Axillary Glands.—Each contained one hemp-seed sized congested caseous nodule.

Thorax.

Pleura.—Between the 7th and 8th ribs on the left side, close to the vertebra, there was a flattened loosely-attached fibro-caseous nodule 7 mm. in diameter. Two other smaller nodules were seen on this side, and there was one situated between the 5th and 6th ribs on the right side. Four were seen on the pleural surface of the pericardium, the largest 7 mm. in diameter.

Diaphragm.—On the pleural surface the villous tufts were hypertrophied and a few opaque foci could be seen in them.

On the peritoneal surface there were a few small scattered yellow tubercles.

Lungs.—The lungs were heavy and voluminous, and weighed 5 lbs. 1 oz. The surfaces were thickly covered with irregular tubercles with grey translucent margins and large irregular yellow centres; these were frequently confluent forming patches up to 1 cm. in diameter. The tubercles varied in size from a pin-head upwards to a hemp seed. On the posterior and dorsal portions of the caudal lobes they were less numerous than elsewhere. On the surface of the anterior and middle lobes there were large and small dark red areas; the right middle lobe was almost entirely dark red. The posterior lobes showed numerous little irregular reddish patches frequently surrounding a tubercle or a group of tubercles.

On section the tubercles were equally numerous; in the consolidated portions of the anterior and middle lobes they were especially thickly packed. The right middle lobe was consolidated almost throughout and sank in water; the other anterior lobes still contained a good deal of air-containing tissue. The right posterior lobe showed small irregular consolidated areas similar to those on the surface, but there was a large amount of air-containing tissue, and the tubercles were less numerous than elsewhere. The left posterior lobe was similar on section to the anterior lobes.

The tubercles were almost entirely caseating. They were frequently confluent, but no large patches were seen.

Thoracic Glands.—The bronchial and mediastinal glands were much enlarged, and weighed altogether 7 ozs. The surrounding tissues were very oedematous. The long mediastinal gland measured 12 by 4.5 by 1.5 cm. On section they were caseating almost throughout, very little gland tissue remaining; the right bronchial was entirely caseated, and similar to the left prescapular.

Heart.—Normal.

Abdomen.

Omentum.—The omentum contained several nodules, some loosely attached; the largest measured 0.6 cm. in diameter, and was composed of caseo-calcareous substance in a fibrous capsule; the others were fibro-caseous.

Parietal Peritoneum.—Normal.

Spleen.—The spleen was slightly enlarged and packed with yellow caseating tubercles from 1 to 2 mm. in diameter.

Liver.—On the surface of the liver there were numerous whitish-yellow tubercles, the majority dimly seen through the capsule. A few of the largest were flattened on the surface and had slightly overhanging margins; one measured 9 mm. by 4 mm., another 4 mm. in greatest diameter. Section showed the tubercles to be evenly and moderately thickly distributed throughout the substance of the liver. They were firm and caseous, and varied from 1 to 2 mm. in diameter.

Portal Glands.—The portal glands were enlarged and oedematous, the largest measuring 5 cm. in long diameter. On section they were packed with confluent caseating nodules, indefinite in outline.

Coeliac Glands.—The coeliac glands were similar to the portal.

Kidneys.—Twenty-five yellowish-white tubercles were counted on the surface of the right kidney, some slightly raised, others dimly seen through the capsule. They measured from 1 to 2 mm. in diameter. Similar tubercles were seen here and there in the

substance of the kidney. The left kidney was similarly affected, 21 tubercles being counted on the surface.

Suprarenal Bodies.—The left showed four yellow tubercles up to 2 mm. in diameter; the right contained one.

Alimentary Tract.

Tongue.—Normal.

Tonsils.—The left contained one millet-seed sized caseating tubercle. The right was normal.

Pharynx.—The corrugated mucous membrane at the back of the pharynx showed six congested caseous tubercles up to a millet seed in size.

Larynx.—There were four yellow congested tubercles in the larynx.

Trachea.—The trachea appeared normal.

Submaxillary Glands.—Each contained two or three yellow caseous tubercles with congested margins.

Retro-pharyngeal Glands.—Each contained a moderate number of congested caseous tubercles in the cortex.

Intestines.—The small intestine was normal. In the caecum there were two small opaque submucous tubercles with congested margins; when picked out they were found to be caseous.

Mesenteric and Ileo colic Glands.—Most of the mesenteric and ileo-colic glands contained scattered caseous foci.

Testicles.—Normal.

Various Lymphatic Glands.

Lumbar and Renal.—These glands were packed with caseating tubercles.

Ileo-Sacral.—The ileo-sacral gland contained several caseating nodules.

Iliac.—Two iliac glands contained each about a dozen caseous nodules up to a hemp seed in size.

Preaural and Popliteal.—Each contained about half a dozen similar caseous nodules.

Pudic.—The one on the left side contained three, that on the right four, caseous nodules.

Ischiatic.—The left contained a caseous tubercle, the right was normal.

Gluteal.—The right contained half a dozen small congested caseous tubercles. The left contained two caseous nodules.

CALF 1489. Virus H 90. "I.P."

Subcutaneous inoculation of culture derived from the pudic gland of Calf 1383.

Dose—50.0 milligrammes.

Date of Inoculation—November 25, 1908. [Age about 6 months.]

Died—January 6, 1909. [42 days after inoculation.]

Clinical Notes.

The course of the disease was like that usually seen after the inoculation of a fatal dose of a virus virulent for bovines, being characterised by weakness, emaciation, and increasing difficulty of respiration.

Temperature.

The temperature was raised and irregular during the week following the inoculation; 40.8°C. was

reached on the 10th day, and the temperature was very high during the following 18 days (maximum 41.3°C., minimum 40.6°C.); it then slowly fell, and 38.6°C. was recorded on the day the animal died.

Weights.

			cwt.	qrs.	lbs.
November 25, 1908	...	...	2	0	15
January 6, 1909...	...	...	1	2	16
Total loss of weight.—1 qr 27 lbs.					
Average rate of loss per week.—8 lbs.					

POST-MORTEM EXAMINATION.

The carcass was emaciated.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a slightly raised tumour fluctuating in the centre measuring 15 by 7 by 3.5 cm.; on section it was composed of a subcutaneous mass of pinkish-yellow caseo-necrotic substance infiltrating the skin and the muscles, and containing in the centre a ragged cavity filled with yellow serous fluid. The tumour was attached to the nearest glands by thick caseous cords.

Left Prescapular Gland.—The left prescapular gland measured 8.5 by 6 by 4.5 cm. and was composed throughout of dense yellow caseo-necrotic substance; the capsule was thickened and in places (i.e. where joined by the caseous cords) infiltrated with caseous substance.

Right Prescapular Gland.—The right prescapular gland measured 4 by 1.7 by 1 cm., and showed in the cortex four caseous nodules, the largest 3 mm. in diameter.

Prepectoral Glands.—On the left side one 1.3 cm. in greatest diameter was indurated and yellow and caseous almost throughout. Another, disc-shaped and 4 cm. in greatest diameter, was firm grey and showed early foci of caseation. Another small one was in a similar condition.

On the right side two contained altogether five caseous nodules up to 2 mm. in diameter.

Cervical Glands.—On the left side at the root of the neck there was a large gland measuring 4.5 cm. in greatest diameter which was dense and caseating practically throughout. Other cervical glands were congested and contained each two or three caseous nodules with congested margins, the largest 2.5 mm. in diameter.

Axillary Glands.—In the left there was one caseous tubercle, in the right there were about half a dozen up to 2 mm. in diameter.

Thorax.

Lungs.—The lungs filled the chest and were very heavy weighing 11 lbs. 4 ozs. and all the lobes were extensively hepatized, dark red in colour and engorged with blood; in the posterior parts of the caudal lobes and around the margins of the cephalic there was some air-containing tissue, but this was firmer than normal and deeply congested; the parenchyma of the lungs was closely beset with yellowish-white caseous tubercles the majority about 1 mm in diameter; a few were larger and here and there some had coalesced; the tubercles under the pleura of the anterior lobes and parts of the caudal projected slightly and were flattened out to a larger diameter than those in the depths.

Thoracic Glands.—The bronchial and mediastinal glands were greatly enlarged weighing together 12 ozs.; on section their cortices were composed of firm pinkish-grey tissue mottled with irregular yellow caseous patches and foci.

Pleura.—The fringes along the margins of the ribs were slightly hypertrophied and deeply congested; they contained sparsely scattered flattened caseating nodules

varying up to 3 mm. in diameter. The diaphragmatic pleura showed a few small flattened nodules and congested villous patches.

Heart and Pericardium.—The heart muscles and valves were normal. There was a hemp seed-sized caseous pedunculated nodule on the surface of an auricle.

Abdomen.

Omentum and Peritoneum.—On the ventral surface of the omentum there were about half a dozen lenticular caseating nodules with congested margins the largest 5 mm. in diameter.

The parietal peritoneum was normal.

Spleen.—The pulp was soft and moderately closely beset with yellow caseous nodules the largest 3 mm. in diameter.

Liver.—The liver was much enlarged yellowish in colour and very friable; the substance contained moderately numerous evenly distributed tubercles ranging from about 0.5 to 2 mm. in diameter, the larger ones were yellow and caseous with grey margins, the smaller ones grey with opaque centres; on the surface there were a few flattened mushroomed nodules.

Portal Glands.—The portal glands were enlarged; their cortices were composed of grey caseating nodules closely aggregated together; in the central parts of the glands the nodules were more discrete.

Kidneys.—In the cortex of each kidney on the surface as well as on section there were scattered caseous nodules ranging from 1 to 2.5 mm. in diameter.

Suprarenal Bodies.—In the cortex of the right there were two greyish-white miliary tubercles. The left was normal.

Coeliac Glands.—The coeliac glands were enlarged and composed throughout of confluent grey nodules in a state of early caseation.

Lumbar and Renal Glands.—The lumbar and renal glands were enlarged and closely beset with caseating nodules.

Alimentary Tract.

The Tongue, Pharynx, Larynx, and Trachea were congested, but no tubercles were seen.

Tonsils.—One tonsil contained a caseous nodule 3 mm. in diameter.

Intestines.—Some of the Peyer's patches in the small intestine contained a few miliary caseous tubercles.

The Mesenteric and Ileo-colic Glands showed in the cortex each a few grey caseating patches some 1 cm. and more in diameter.

Testicles.—Normal.

Various Lymphatic Glands.

The Preaural, Popliteal, Iliac, Submaxillary, Parotideal, and Retro-pharyngeal Glands contained a varying number of discrete caseating nodules in the cortex the largest 3 mm. in diameter, the iliac and submaxillary containing a moderate number.

CALF 1493. Virus H 90. "I.P."

Subcutaneous inoculation of culture derived from the bronchial gland of Calf 1471.

Dose—45.0 milligrammes.

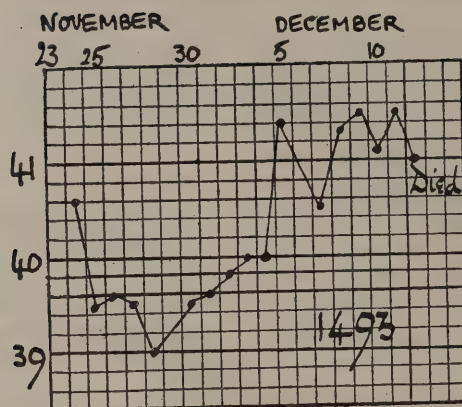
Date of Inoculation—November 23, 1908. [Age about 6 months.]

Died—December 14, 1908. [21 days after inoculation.]

Clinical Notes.

The illness was of the acute type frequently seen after the inoculation of virulent viruses.

Temperature.



Tuberculin Test.

The calf was not tested subsequent to inoculation.

Weights.

		cwt.	qrs.	lbs.
November 23, 1908	...	1	3	11
December 14, 1908	...	1	2	3

Total loss of weight.—1 qr. 8 lbs.

Average rate of loss per week.—12 lbs.

POST-MORTEM EXAMINATION.

The carcass was emaciated.

Local Lesion.—In the subcutaneous tissues on the left side of the neck there was a lenticular mass of yellow caseo-necrotic substance measuring 10 by 8 by 2 cm., infiltrating the skin to a slight extent and the muscles in one place rather deeply.

Left Prescapular Gland.—The left prescapular gland measured 9 by 5 by 3 cm., and was dense yellow and caseous practically throughout.

Right Prescapular Gland.—The right prescapular gland measured 5 by 2 by 1 cm., and showed scattered minute tubercles on section.

Prepectoral Glands.—On the left side one 2 cm. in diameter was caseous throughout, another larger flat gland showed the cortex grey and in a state of early caseation; another gland contained discrete tubercles. The glands on the right side contained scattered minute tubercles.

Cervical Glands.—One in the middle of the neck on the left side, the size of a thrush's egg, was firm and in a state of early caseation; the other cervical glands were deeply congested and showed scattered tubercles, as in the peripheral glands.

Thorax.

Pleura.—The fringes along the margins of the ribs were slightly hypertrophied and deeply congested; no tubercles were seen.

Lungs.—The lungs did not collapse and filled the chest; they were heavy, weighing 9 lbs. 14 ozs., and with the exception of the postero-dorsal parts of the caudal lobes, which were still air-containing, were dark-red and solid, portions sinking in water; the parenchyma of the lungs was everywhere very closely beset with minute grey tubercles.

Thoracic Glands.—The bronchial and mediastinal glands were enlarged, deeply congested, and showed in the cortex grey patches composed of aggregated grey tubercles and discrete grey miliary tubercles.

Heart.—The cavities of the heart were filled with red blood-clot; the endocardium of the right auricle and right ventricle showed a few small caseous tubercles. The pericardium was normal.

Larynx and Trachea.—The mucous membrane of the larynx and trachea was congested.

Abdomen.

Omentum.—There were four small tubercles on the omentum.

Peritoneum.—The peritoneum appeared normal.

Spleen.—The spleen was not enlarged; the capsule was wrinkled and the pulp was soft and seemed a little atrophied; it showed numerous not very conspicuous grey bodies, probably enlarged Malpighian bodies, which showed no sign of caseation.

Liver.—The liver was enlarged, pale and soft, and contained fairly numerous evenly distributed grey miliary tubercles.

Portal Glands.—The portal glands were not obviously enlarged. The tissue was oedematous and the cortex contained grey patches with early caseous foci.

Kidneys.—In the cortex of each kidney there were a few minute grey tubercles.

Suprarenal Bodies.—Normal.

Alimentary Tract.

Pharynx.—The mucous membrane of the pharynx was congested.

Tonsils.—The tonsils were congested, no tubercles were seen.

Intestines.—Some of the Peyer's patches of the small intestine showed a few greyish-white points. The large intestine was normal.

Mesenteric Glands.—No tubercles were seen.

Ileo-colic Glands.—A few tubercles were seen in one gland.

Testicles.—Normal.

Various Lymphatic Glands.

All the peripheral lymphatic glands showed in the cortex scattered opaque tubercles less than 1 mm. in diameter.

There were similar but more numerous tubercles in the coeliac, lumbar, and renal glands.

Microscopical Examination.

Smear from a focus in a Peyer's patch.—A few tubercle bacilli.

SUBCULTURES ON GLYCERINATED POTATO:—

(a) *Of the initial culture and some of the separated cultures of Virus H. 13. "A.D." (Calf 301 strain).*



No. 1. The growth produced by the initial culture (eugonic and virulent).
 Nos. 2 and 5. Growths produced by colonies (Nos. 2 and 10) from a serum plate (eugonic and virulent). See Table D.
 No. 3. The growth produced by a colony (No. 3) from a serum plate (eugonic and slightly virulent). See Table D.
 No. 4. The growth produced by a colony (No. 4) from a serum plate (dysgonic and virulent). See Table D.
 No. 6. The growth produced by a colony from a serum agar plate (eugonic and slightly virulent). See Table E.

No. 7. The growth produced by the initial culture (eugonic and virulent).
 No. 8. The growth produced by a single colony from a serum plate (eugonic and slightly virulent). See Table O.
 Nos. 9 and 10. Growths produced by cultures isolated from animals inoculated with the initial culture (dysgonic and virulent). See Tables M and N.

culture of the
Virus H. 90.
"I.P." (retro-
peritoneal gland
strain).

(b) Of the initial culture and two of the separated
cultures of the Virus H. 60. "W.B." (bronchial
gland strain).

(a) Of the initial culture and some of the separated cultures of the Virus H. 13. "A.D." (Calf 301 strain).



1. No. 1. The growth produced by the initial culture (eugonic and virulent).
Nos. 2 and 3. Growths produced by colonies (Nos. 2 and 7) from a serum plate (eugonic and virulent).
See Table D.
2. Nos. 4, 5, and 6. Growths produced by cultures isolated from passage animals (dysgonic and virulent).
See Table A.
3. No. 7. The growth produced by the initial culture (eugonic and virulent).
Nos. 8 and 9. Growth produced by cultures isolated from animals inoculated with the initial culture (dysgonic, No. 9 virulent). See Tables L and M.
4. No. 10. The growth produced by the initial culture (eugonic and virulent).

REPORTS ON THE EXCRETION INTO THE MILK OF
COWS AND GOATS, AND INTO THE MILK SINUSES
OF THE UNDEVELOPED UDDERS OF HEIFERS, OF
TUBERCLE BACILLI WHICH HAD BEEN SUBCU-
TANEOUSLY OR INTRAVENOUSLY INOCULATED.

BY

A. STANLEY GRIFFITH, M.D.

THE EXCRETION OF TUBERCLE BACILLI IN MILK.

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Part I.

THE EXCRETION OF TUBERCLE BACILLI INTO THE MILK OF COWS AND GOATS.

INTRODUCTION.

IN spite of numerous observations on naturally tuberculous cows, it has not yet been definitely settled whether the normal udder will permit the passage of tubercle bacilli from the blood-stream into the milk.

Positive results have been obtained by many investigators with milk from tuberculous cows in which no disease of the udder could be detected either macroscopically or microscopically, but these cannot be accepted as proof that the bacilli were excreted in the milk directly from the blood-stream, since the bacilli may have been introduced accidentally while collecting the samples or have escaped into the milk from some early and undetected tuberculous lesion in the udder.

Accidental contamination can be avoided, and has been in the more recent experiments in which positive results have been obtained, but it is doubtful whether any examination can be so exhaustive as definitely to exclude the presence of early lesions in the udder.

It seemed to me, therefore, that the question whether tubercle bacilli can pass from the blood into the milk without producing changes in the mammary tissue could be solved only by direct experiment, *i.e.* by introducing tubercle bacilli into the blood-stream of a healthy cow and testing her milk at short intervals subsequently. If such experiment showed that tubercle bacilli so introduced were excreted in the milk within a short period after their inoculation into the blood-stream there would arise strong presumption that a similar excretion takes place during the progress of a natural infection.

A preliminary experiment was therefore made at Walpole Farm with a culture of bovine tubercle bacilli. A cow was inoculated subcutaneously with 100·0 milligrammes of culture, and her milk tested at intervals after the inoculation produced tuberculosis in guinea-pigs. The subcutaneous method of inoculating the cow was chosen instead of the intravenous, as it was anticipated that the latter method of inoculating bovine tubercle bacilli would cause the too speedy death of the animal, and as it had been shown that after subcutaneous inoculation there is an immediate and for several days a rapid escape of bacilli into the blood-stream.

It was inferred from the results of the guinea-pig inoculations in this experiment that the milk of a tuberculous cow is liable to contain tubercle bacilli whenever tubercle bacilli gain access to the general circulation.

This experiment (Experiment A) has already been fully reported (Appendix to the 2nd Interim Report, Vol. I, pp. 35 and 226) but for convenience of reference the details have been reproduced in this report.

In order to ascertain whether a similar excretion takes place after the inoculation of tubercle bacilli possessed of slight virulence for the calf, a series of three cows and six goats has been inoculated and the milk of these animals tested frequently at short intervals subsequently; in addition a goat has been inoculated with a culture of human origin but exhibiting bovine characters.

The clinical histories and post-mortem notes of these animals, and the results of the inoculation of their milk, are fully detailed in this report.

All the animals previous to their inoculation had been tested with tuberculin and their milk inoculated into guinea-pigs; the results in all cases were negative.

TECHNIQUE.

The milk of the first two cows (300 and 77) was collected by hand; the teats, udder and surrounding skin were carefully cleansed and then washed in a 1 in 1,000 solution of mercury perchloride; finally the teats and udders were washed with alcohol; the first few drops of milk were rejected and in the case of the first two

cows the samples for inoculation were received into sterile glass bottles held at an angle to avoid as far as possible the entrance of chance particles of dust.

The milk from the other animals, with the exception of Goat 81, was obtained by catheterisation, the same precautions as to cleanliness of the udder and surrounding skin being observed as with the first two cows.

In all cases the milk was collected by me or by a skilled attendant under my direct supervision. In every case the udder was milked dry just before the animal was inoculated, and whenever samples were taken no milk had been withdrawn during the previous twenty-four hours.

The amount of milk inoculated into the guinea-pigs varied. Sometimes the milk was centrifuged with a hand centrifuge and the deposit was suspended in uncentrifuged milk for the purposes of inoculation, but in the large proportion of cases the milk was uncentrifuged, the dose varying from 0.5 or 1.0 cc. up to 30.0 cc. In the first two experiments the dose in nearly every case was 5.0 cubic centimetres of uncentrifuged milk; in the others the dose was generally 10.0 cubic centimetres.

EXPERIMENT A.

Cow 300 was inoculated subcutaneously in the neck on September 2, 1905, with 100.0 mg. of a bovine culture and her milk tested on guinea-pigs subsequently at intervals of 7, 16, 21, 28 and 30 days after her inoculation; also two pigs were fed with her milk for a week.

The experiments on the guinea-pigs showed that the milk was capable of setting up tuberculosis at the end of the first week and on every subsequent occasion. The number of tubercle bacilli excreted in the milk did not appear to be large since most of the guinea-pigs developed only a mild type of disease and the swine though fed for a week with the milk did not become tuberculous.

The cow died of acute generalised tuberculosis in 30 days; the udder was normal to the naked eye and no tuberculous lesions or tubercle bacilli were found on microscopical examination.

EXPERIMENT B.

Cow 77 was inoculated subcutaneously on November 28, 1906, with 100.0 milligrammes of culture derived from the original material of Virus H 68. "R.B." (a case of tuberculous osteitis); this culture grew luxuriantly on artificial media and was only slightly virulent for the calf and rabbit.

The general health of the cow was unaffected by the inoculation, and the local lesion which developed at the seat of inoculation diminished greatly in size and was represented finally by a small patch of thickening. The cow, which was killed in good health 156 days after inoculation, showed at the post-mortem examination a fibrous local lesion, a caseo-purulent nodule in the prescapular gland, but no sign of tuberculosis elsewhere. Each quarter of the udder was examined histologically by Dr. Eastwood but no tuberculous lesions or tubercle bacilli were found.

Throughout the first week of the experiment a series of eight guinea-pigs was inoculated every twenty-four hours, then for twelve weeks a series of eight at intervals of about a week; the last two series were inoculated after 112 and 155 days, and each included twelve guinea-pigs.

Altogether seventeen series, comprising 144 animals, were inoculated. Each guinea-pig in the first fifteen series received 5.0 cc. of milk; two were inoculated from each quarter, one subcutaneously and one intraperitoneally. In the sixteenth series eight of the guinea-pigs received 5.0 cc. of milk, the other four each got the centrifuged deposit of 100.0 cc. For the last series the whole of the milk yielded during twenty-four hours was centrifuged, and the deposit from each quarter inoculated into three guinea-pigs.

In all but two of the series (*i.e.* the fifth, in which none of the animals became tuberculous, and the tenth, in which the one animal which was affected had spontaneous tuberculosis) one or more of the guinea-pigs inoculated developed definite inoculation tuberculosis. Of the first day's milk, *i.e.* that secreted during the 24 hours after inoculation of the cow, that from two of the quarters only proved infective; on the second and third days milk from all the quarters produced tuberculosis. From the end of the third week to that of the thirteenth, one, or at most three, of the guinea-pigs in each series became tuberculous. In the last series of twelve guinea-pigs, which were inoculated with centrifuged deposit, one from each of three quarters and two from the other became tuberculous.

Two rabbits were inoculated, one subcutaneously and one intraperitoneally, with mixed milk taken from all the quarters just before the cow was killed. They were killed 92 days later, the subcutaneously inoculated rabbit showing a local lesion and one tubercle in the lung, the intraperitoneally inoculated rabbit three or four tubercles in the omentum, one in a kidney, and one in the lung.

In order to ascertain whether the tuberculosis in the guinea-pigs in the last three series was produced by bacilli of like kind with those inoculated into the cow, ten rabbits were inoculated with emulsions of the organs of eight guinea-pigs and in addition a culture was isolated from each of these guinea-pigs.

Three of the rabbits died prematurely, the others showed slight retrogressive tuberculosis. All the cultures isolated grew luxuriantly on the test media. The properties of the bacilli excreted in the milk were therefore precisely those of the bacilli inoculated under the skin of the cow.

EXPERIMENT C.

Cow 61 was inoculated subcutaneously on August 6, 1907, with 100·0 milligrammes of a slightly virulent culture obtained from a tuberculous lung (Virus H 81. "P.W."). She was an old cow and was giving only a very small amount of milk; her last calf had been born on October 15, 1905. One of the quarters of her udder, the right fore, was atrophied, and had for some time yielded only a small quantity of serous fluid and yellow clots in which numerous streptococci were demonstrated.

Nine series of guinea-pigs were inoculated with the milk, three series in the first week after her inoculation, the last series after eighty-four days. Only one of the guinea-pigs became tuberculous. This guinea-pig was one of the series inoculated on the seventh day and had received intraperitoneally 10·0 cc. of fluid obtained by filtering clots which had been withdrawn by hand from the right fore quarter. A culture isolated from the guinea-pig grew like the culture inoculated into the cow.

Ninety days after the subcutaneous inoculation the cow was inoculated intravenously with 150·0 milligrammes of culture from Virus H 83. "G.C.," a slightly virulent culture obtained from the spleen of a child who died of general tuberculosis. A series of guinea-pigs was inoculated with her milk every day (except on the fourth) during the first eight days, then on the tenth, twelfth, fifteenth and forty-fourth days, and one guinea-pig on the eighty-fifth day. All the guinea-pigs, fourteen in number, inoculated one and two days after the inoculation of the cow, became tuberculous; in the third series four out of the six developed tuberculosis; and the milk continued to be infective up to the forty-fourth day, the single guinea-pig inoculated on the eighty-fifth day remaining healthy.

Cultures were isolated from seven of the tuberculous guinea-pigs, and these all exhibited the cultural characters of the bacillus intravenously inoculated.

As in Cow 77, an irregularity in the infectivity of the milk was observed; of a pair of guinea-pigs inoculated from the same quarter one would be found tuberculous, the other healthy, and the milk from a quarter which produced tuberculosis on one occasion would on the next fail to do so.

By the 85th day, that is on January 28, 1908, the secretion of milk had practically ceased and the routine inoculations of guinea-pigs was discontinued.

The milk had been examined microscopically for tubercle bacilli on several occasions during the first ten days after the cow was intravenously inoculated, but none was demonstrated in it.

From January 28 to April 14, 1908, the udder of the cow was not meddled with.

On the latter date (162 days after the intravenous inoculation) the two fore-quarters were milked and some pus was obtained from each; smear preparations from the pus showed in each case very numerous tubercle bacilli, the majority being long and beaded; there were numerous cells, mainly polymorphonuclears with scattered lymphocytes and alveolar cells.

On the following day 50·0 cc. of sterile salt solution were injected into each of the two fore-quarters, and after manipulating the quarters with the object of forcing the fluid into the smaller ducts, as much as possible was recovered by means of the apparatus which had been used for injecting the salt solution; only a small quantity of the fluid was recovered, and this was slightly milky and contained small flakes and flocculi; smear preparations of this fluid showed numerous tubercle bacilli.

Subsequent microscopical examinations of the fluids which collected in the milk sinuses were made at intervals.

The following table gives the results of these examinations on and after April 14, 1908 :—

Date.	Quarter of Udder.	Description of Material.	Result of Examination.
April 14, 1908 ...	L.F.... ... R.F.... ...	} Pus	{ Numerous T.B. Cells mainly polymorpho-nuclears; scattered lymphocytes and alveolar cells.
April 15, 1908 ...	L.F.... ... R.F.... ...	{ Fluid recovered after injecting salt solution.	Numerous tubercle bacilli.
April 21, 1908 ...	L.H. R.H.	} Pus	{ Fairly numerous T.B., definitely less numerous than in the fore quarters.
June 2, 1908 ...	L.F.... ... R.F.... ...	} A few drops of pus...	T.B. numerous.
July 1, 1908 ...	Mixed fluids from all the quarters.	Yellow muco-purulent fluid.	T.B. numerous.
July 17, 1908 ...	L.F.... ... R.F.... ... L.H. R.H.	{ A few drops of purulent fluid. " " "	{ T.B. numerous. A few clumps of very short T.B., quite different from those in the other quarters.
August 6, 1908 ...	L.F.... ... R.F.... ... L.H.	} Pus	{ T.B. fairly numerous, but distinctly less numerous than when first examined in April
Sept. 15, 1908 ...	L.F.... ... R.F. L.H. R.H.	Yellow muco-pus with small flakes. Yellow muco-pus ... Thick tenacious yellow pus. Milky watery fluid ...	A moderate number of tubercle bacilli. Scattered beaded T.B. and a few clumps. A few small groups of very short acid-fast bacilli and granules; the cells were chiefly polymorpho-nuclears.
October 6, 1908 ...	L.F.... ... R.F.... ... L.H. R.H.	Yellow tenacious muco-pus. Serous fluid containing small whitish flakes Thick yellow tenacious pus. Muco - purulent substance and serous fluid.	{ T.B. moderately numerous. T.B. rather more numerous than in the fore quarters. One T.B. and a few groups of acid-fast granules.
October 15, 1908...	L.F.... ... R.F.... ... L.H. R.H.	Yellow pus Yellow pus in which a calcareous grain was found. Yellow pus Milky fluid on which on standing a layer of cream formed.	T.B. moderately numerous. T.B. in moderate numbers. A few small groups of short acid-fast bacilli; many short chains of cocci.
January 14, 1909...	L.F.... ... R.F.... ... L.H. R.H.	Yellow pus, thick and tenacious. Watery fluid with whitish flakes. Yellow pus, thick and tenacious. Turbid watery fluid with flakes of yellow pus.	T.B. moderately numerous. Scattered T.B. seen. A moderate number of T.B. seen. No T.B. seen.
April 15, 1909 ...	L.F.... ... L.H. R.H.	Yellow pus " " " "	Numerous long and beaded T.B. A moderate number of T.B. A few acid-fast granules only were seen.

Towards the end of June, 1908, that is nearly eight months after her intravenous inoculation, it was observed that three of the quarters of the cow had become enlarged and somewhat indurated, and that there was a sero-purulent discharge from the two fore teats. A fortnight later there was a distinct increase in the size of the three quarters; the left fore and the left hind were uniformly indurated, the right fore was indurated and nodular; the right hind showed no alteration in size.

On July 1, 1908, each of the quarters was milked dry because it was noticed that three of the sinuses were becoming distended. Altogether 450·0 cc. of yellow tenacious muco-purulent fluid was withdrawn; there was practically none in the right hind quarter. With the exception of the few drops required for microscopical examination nothing had been withdrawn from the udder for six months.

On the next day 250·0 cc. were obtained, and on the next 100·0 cc.; the latter was more serous than the first, but still very turbid.

Subsequently the amount of discharge rapidly became less and after July 17 small quantities only of pus were obtained.

After attaining its maximum size on or about July 1, the udder underwent no appreciable alteration for some time; on October 15, 1908, it was thought to be on the whole a little smaller; the quarters on the left side were each larger than the right fore and were uniformly very knotty and indurated; the right fore was less uniformly indurated and could be resolved more easily into separate nodular or knotty areas; the right hind was small and atrophic and no nodules were felt in it. Subsequent to this date there was a gradual diminution in the size of the organ, and it was found on April 15, 1909, the day before the cow was killed, when an attempt was made to wash out the quarters, that the milk sinuses of two of the quarters were much contracted and the ducts apparently obliterated, and in the case of one of the quarters it was impossible to insert the cannula on account of the teat canal being filled with a firm cheesy substance.

The cow was killed on April 16, 1909, 529 days after the intravenous inoculation; the post-mortem examination showed in the caudal lodes of the lungs a few dense or softened caseous and calcareous nodules of various sizes, a large fibro-caseous mass with two small nodules in the long mediastinal gland, gritty caseous nodules in the suprarenal bodies, caseo-purulent nodules in the pancreas and tuberculosis of the udder which was atrophied and fibroid (*see* page 109). There was no lesion at the site of the subcutaneous inoculation and the adjacent prescapular gland was normal.

The virulence of the tubercle bacilli in the milk sinuses has been tested by the inoculation into rabbits both of the fluids recovered from the quarters after injecting saline and of cultures obtained direct from the purulent discharge.

Thus:—Washings from the quarters have been inoculated into rabbits on three separate occasions, on April 15, and October 15, 1908, and on April 15, 1909, and in each series of rabbits slight tuberculosis only was produced. And cultures of tubercle bacilli have been obtained direct from the pus of the mamma of the cow on four separate occasions, on April 15, August 6, and October 7, 1908, and on April 15, 1909. All these strains have grown on the test media exactly like the culture intravenously inoculated, and three, including one isolated on April 15, 1909, have been shown to possess for the rabbit the low virulence of the original culture.

The bacilli from the milk sinuses had not, therefore, undergone any alteration in cultural characters and in virulence for the rabbit after a residence in the body of the cow of 528 days.

In the early part of the experiment streptococci were often demonstrated in the milk and were particularly numerous in the clots from the right fore quarter. On October 7, 1908, a culture tube sown with fluid from the right hind quarter became covered in 48 hours with streptococcus colonies. The cultures of tubercle bacilli obtained from the other quarters did not show any streptococcus colonies and no organisms other than tubercle bacilli had been demonstrated in smear preparations from these quarters during the period from April 14, 1908. The streptococci therefore had disappeared from those quarters in which there had been a multiplication of tubercle bacilli and had persisted in the single quarter which had not become affected with tuberculosis.

The positive results with the milk of this cow after tubercle bacilli had been inoculated directly into the blood-stream supplies a possible explanation of the

negative results after the subcutaneous inoculation, namely that the subcutaneous inoculation was followed by only a slight dissemination of tubercle bacilli.

This slight dissemination of bacilli may have been due to the condition of the culture. It not infrequently happens that bacilli of Group II grow on serum very quickly and luxuriantly and then apparently rapidly lose their vitality; this loss in vitality is shewn in the difficulty sometimes experienced in obtaining subcultures (on serum) from such cultures when they are not more than three weeks or a month old.

The faeces of the cow were inoculated into sixteen guinea-pigs, six after the subcutaneous inoculation and ten after the intravenous. Seven guinea-pigs died shortly after inoculation, eight were killed and found to be healthy, one only became tuberculous. The guinea-pig that became tuberculous was inoculated ten days after the intravenous inoculation of the cow.

EXPERIMENT D.

Cow 565 was inoculated intravenously on February 18, 1909 with 10·0 milligrammes of a Group II culture obtained from a tuberculous human lung (Virus H 104. "E.R.")

The cow, $4\frac{1}{2}$ years old, was about 4 months pregnant; one of her quarters was "dry."

The milk from the three functional quarters was inoculated into a series of six guinea-pigs, two from each quarter, every day during the first seven days (the first series being inoculated twenty-four hours after the inoculation of the cow), and again at the end of a fortnight; between the 14th and the 168th day seven series of guinea-pigs were inoculated, the intervals ranging from two to four weeks; in the last fortnight four series of guinea-pigs were inoculated.

In the first series of guinea-pigs, *i.e.* those inoculated with milk secreted during the first twenty-four hours of the experiment, only one animal became tuberculous. All the animals in the second, third, and fourth series remained healthy. In the fifth series there were two, in the sixth one and in the seventh four tuberculous animals. The milk from each of the three quarters withdrawn on the 14th day produced tuberculosis in one of each pair of guinea-pigs inoculated, the other remaining free from tuberculosis. Tuberculosis was not produced in any of the guinea-pigs inoculated subsequently.

Two pigs were fed for seven days with milk withdrawn during the period included between the second and the eighth days after the inoculation of the cow; they together received all the milk yielded with the exception of that used for the guinea-pigs. They were killed 97 days after the experiment began; one was healthy, the other showed a calcareous tubercle in one submaxillary gland.

In this case therefore persistence of tubercle bacilli in the milk sinuses was not demonstrated. The negative results do not however prove that the milk sinuses were free from bacilli since only a small proportion of the total amount of milk secreted was inoculated; tubercle bacilli were no doubt present in the milk secreted on the second, third, and fourth days but in such small numbers that the samples inoculated, $\frac{1}{70}$ to $\frac{1}{80}$ of the total yield, did not happen to include any. It is to paucity of bacilli and the inoculation of only a small proportion of the milk yielded that the irregularity of the results in those series in which some of the guinea-pigs became tuberculous is to be attributed rather than to intermittent discharge of bacilli into the milk. An inspection of the table on page 118 shows that frequently only one of the guinea-pigs inoculated with milk from the same quarter became tuberculous and that milk from a quarter which on one occasion produced tuberculosis was not on the next infective.

The cow 153 days after her inoculation gave birth to a dead foetus (eight months old); during parturition a large amount of thin purulent fluid was discharged from the uterus; microscopical examination showed this fluid to contain very numerous tubercle bacilli. During the next two or three days there was a slight discharge and on the sixth day some membranes and purulent fluid came away; numerous tubercle bacilli were again demonstrated in the fluid. The foetus showed no sign of tuberculosis and emulsions made from its spleen and a portal gland did not produce tuberculosis in guinea-pigs.

The cow was killed 182 days after inoculation; there was no sign of tuberculosis in any of her organs or glands but a few tubercle bacilli were found in smear preparations of scrapings from the mucous membrane of one cornu of the uterus.

EXPERIMENT E.

Goat 79 was inoculated subcutaneously on November 12, 1908, with 50·0 milligrammes of a lupus culture (H 110. "J.B." (a)) possessing all the properties of a culture of bovine tubercle bacilli, and was killed 9 days later.

The post-mortem examination revealed a local lesion, early caseation of the pre-scapular gland and moderately numerous small tubercles in the lungs; there was no sign of disease elsewhere.

When inoculated the goat was giving only a small quantity of milk and after inoculation she soon became "dry," no milk being obtained from the right half of her udder after the fourth day or from the left after the sixth day.

The milk withdrawn at intervals of twenty-four hours, during four days in the case of the right half of her udder and six days in that of the left, was inoculated into guinea-pigs. On the first and also on the second day four guinea-pigs were inoculated, two from each half of the udder, the doses varying from 10 to 4·5 cubic centimetres, but subsequently sufficient milk was yielded to inoculate only one guinea-pig from each half; the amount obtained from the left half of the udder on the fifth as well as on the sixth days was only 0·5 cubic centimetre.

Only one of the eight guinea-pigs inoculated with milk from the left side became tuberculous. Milk withdrawn from the right side twenty-four hours after inoculation did not produce tuberculosis, while that withdrawn on the second, third, and fourth days did.

Just before the goat was killed the milk sinuses of the udder were washed out with sterile salt solution, and a milky fluid was recovered from each side which was inoculated into two guinea-pigs. The two guinea-pigs inoculated with the fluid from the left half remained healthy while those from the right half became tuberculous.

Microscopical examinations of the milk on several occasions and of the recovered saline solution were negative as regards presence of tubercle bacilli.

In this experiment tubercle bacilli had passed out into the milk mainly from one half of the mamma and from that half which was giving the least amount of milk.

EXPERIMENT F.

Goat 55 was inoculated subcutaneously on November 14, 1907, with 50·0 milligrammes of culture* obtained from the mesenteric glands of an old man (Virus H 90. "I.P."), and was killed 103 days after. At the post-mortem examination there was a scar at the seat of inoculation with caseous nodules in the subcutaneous tissues around; both pre-scapular glands were caseous the left more than the right; one kidney contained a nodule; the mesenteric glands were tuberculous; and there were several miliary tubercles in the left quarter of the udder, and a caseating patch in the right.

During the first eight days guinea-pigs were inoculated with the milk at intervals of twenty-four hours; during the remaining period guinea-pigs were inoculated on the fourteenth, twenty-first, and seventy-fifth days only. In each series some or all the guinea-pigs developed tuberculosis; the milk from the left half of the udder was invariably infective, that from the right occasionally failed to infect. It is to be noted that the left quarter during life generally yielded less milk than the right, and the post-mortem examination showed in it a greater amount of tuberculosis.

Cultures isolated from two of the tuberculous guinea-pigs, Nos. 2736 and 2791, grew luxuriantly on the test media, and one (Guinea-pig 2791 strain) had low virulence for the rabbit.

Eight guinea-pigs were inoculated intraperitoneally each with 1·0 cc. of an emulsion of faeces prepared by diluting 1·0 cc. of thick filtered suspension to 20·0 cc. Four of the guinea-pigs died soon after inoculation; the other four were killed after several months and found to be free from tuberculosis.

EXPERIMENT G.

Goat 59 was inoculated subcutaneously on November 28, 1907, with 100·0 milli-

* When used for inoculation this culture was believed to be an ordinary slightly virulent human tubercle bacillus; there is now evidence to show that it contained a small proportion of virulent tubercle bacilli.

grammes of culture derived from the lung of a man (H 79. "J.N."); the culture was slightly virulent for the calf and rabbit, and grew luxuriantly on culture media.

The goat was killed in good health 106 days after the inoculation, and showed a scar at the seat of inoculation with caseo-calcareous tubercles in the subcutaneous tissues around, caseation of the prescapular gland, some doubtful tubercles in the lung, a few tubercles in the spleen, and tuberculosis of the mesenteric and ileo-colic glands; the udder appeared normal.

Guinea-pigs were inoculated with the milk every day except the third during the first six days. All these guinea-pigs, twenty in number, became tuberculous.

After the sixth day no further observations were made on the infectivity of the milk. At the time of inoculation the goat was giving a very small quantity of milk, and after the sixth day the amount rapidly diminished, and in a short time the secretion ceased altogether.

A culture isolated from one of the tuberculous guinea-pigs, No. 2797, grew like the culture inoculated into the goat.

EXPERIMENT H.

Goat 69 was inoculated subcutaneously on June 3, 1908, with 10·0 milligrammes of culture obtained from cerebro-spinal fluid (H 98. "B.R."). This culture grew luxuriantly on artificial media and had low virulence for the rabbit.

The milk of the goat was subsequently inoculated into a series of four guinea-pigs on the first, second, third, fifth, and seventh days during the first week, and then once a week for three weeks; a final series was inoculated on the 44th day after the inoculation of the goat.

Altogether 36 guinea-pigs were used.

All the guinea-pigs inoculated with the milk withdrawn during the first week remained healthy; all those inoculated on the 14th day (with one exception) and subsequently, developed tuberculosis.

In this case, therefore, the bacilli did not appear in the milk so quickly as in the other like experiments, probably because the dose was so much smaller.

The general health of the goat was good throughout the experiment. The amount of milk secreted in a day was never very large; during the first month the daily yield varied from 100·0 to 300·0 cc. of which usually only 40·0 cc. were inoculated into guinea-pigs; after the first month the secretion of milk gradually diminished and towards the end of the second month ceased altogether.

On July 15, 42 days after inoculation, the mamma of the goat was found to be enlarged; on palpation the enlargement affected mainly the right half which was uniformly indurated and knotty; the left half was not obviously enlarged but contained some hard nodules just above the teat; the milk at this time was much diminished in amount but showed no alteration in quality; later on the left half became more uniformly indurated; during the latter part of the experiment the mamma remained indurated but decreased a little in size.

Microscopical examinations of the milk were made at intervals for the presence of tubercle bacilli.

One (?) tubercle bacillus was found in the centrifuged deposit of milk withdrawn on the second day from the right half of the mamma; in centrifuged deposit of milk taken from the same side on the 14th day five tubercle bacilli were found; other examinations were negative.

On the 42nd day a loopful or two of the milk from each half of the mamma was sown on to egg tubes; pure cultures of the tubercle bacillus were obtained in each case, the colonies being more numerous on the tube sown with milk from the right quarter than on that sown with milk from the left. The cultures grew on glycerin media like the original.

The goat was killed 114 days after inoculation, and showed at the post-mortem examination an encapsuled caseous mass at the seat of inoculation and enlargement and induration of the mamma which was beset with miliary caseous tubercles, but no sign of tuberculosis elsewhere.

No tubercle bacilli were found in the milky fluid in the sinuses nor in some of the distended alveoli (milk cysts); a few tubercle bacilli were found in a smear made from the miliary tubercles.

Cultures were sown with some of the fluid withdrawn with a pipette from the milk sinuses after death and also with fluid from two milk cysts. All the tubes sown

with milk from the sinuses grew numerous colonies of tubercle bacilli in pure culture ; numerous colonies were also obtained from one of the milk cysts on the left side ; the tubes sown with milk from a cyst on the right side remained sterile. The different strains grew on glycerin media like the culture inoculated.

EXPERIMENT I.

Goat 61 was inoculated subcutaneously on July 27, 1908, with 1·0 milligramme of one of the easy growing slightly virulent lupus cultures (H 109. "M.W.").

The milk of the goat was inoculated into guinea-pigs on thirteen separate occasions, at frequent intervals during the first month and at longer ones subsequently, the last series being inoculated 197 days after the inoculation of the goat. Altogether fifty guinea-pigs were inoculated, the majority receiving 10 cubic centimetres each.

Not one of the guinea-pigs developed tuberculosis.

The goat when inoculated was suckling a kid ten weeks old. During the first seventeen days after her inoculation the kid was not allowed to suck, but from the 17th to the 171st days the kid took all the milk with the exception of that which had been withdrawn for the purpose of inoculating guinea-pigs. On the latter date, that is when the feeding experiment had lasted 154 days, the kid was killed ; there was no sign of tuberculosis in any of its organs or glands.

The mother goat was killed 197 days after inoculation and showed slight tuberculosis at the seat of inoculation only.

The experiment with this goat was negative probably because on account of the smallness of the dose subcutaneously inoculated there had been little or no dissemination.

EXPERIMENT J.

Goat 81 was inoculated intravenously on December 18, 1908, with 2·0 milligrammes of a slightly virulent human tubercle bacillus (H 115. "N.G.").

The milk of the goat was inoculated into five series of guinea-pigs at intervals of twenty-four hours during the first three days after inoculation, then on the 8th and 15th days, four guinea-pigs each receiving 10 cc. being inoculated on each occasion.

All the guinea-pigs in the first two series became tuberculous, while in the third only one developed tuberculosis ; in the fourth and fifth series three of the four guinea-pigs became tuberculous, the fourth remaining healthy.

A few days after the last series of guinea-pigs was inoculated, the secretion of milk ceased and the udder became dry. At this time the goat was obviously ill ; she gradually became worse and died on January 28, 1909, 41 days after inoculation. The post-mortem examination showed tuberculous pneumonia, enlargement and congestion of the thoracic glands, but no sign of disease elsewhere. Before the *sectio cadaveris* was begun the milk sinuses of each half of the udder were washed out with salt solution ; 4·0 cc. of milky fluid was recovered from the right and 5·0 cc. from the left half, and each of these quantities was divided and inoculated into two guinea-pigs ; all four guinea-pigs developed general tuberculosis.

In this case therefore tubercle bacilli which had been injected intravenously were demonstrated in the milk secreted during the twenty-four hours following inoculation and on every subsequent occasion up to the 15th day. At the end of the third week the secretion of milk had ceased, but tubercle bacilli were shown to be present in the small quantity of milk which existed in the milk sinuses when the animal died on the 41st day.

EXPERIMENT K.

Goat 75 was fed, on a single occasion, September 22, 1908, through a stomach tube with 74·0 milligrammes of culture of a slightly virulent human tubercle bacillus (H 76. "G.M.").

Guinea-pigs were inoculated with her milk at frequent intervals during the first three weeks and at longer ones subsequently, the last series being inoculated 258 days after the goat was fed. Altogether eleven series comprising 42 guinea-pigs were used. None of the guinea-pigs became tuberculous.

Eight months after the experiment began the goat gave birth to two kids which she suckled for nearly two and a-half months ; when killed at the end of this period they were found to be perfectly healthy.

The mother goat was killed 328 days after the experiment began and showed calcareous tubercles in some of the neck and mesenteric and ileocolic glands and in one portal gland but no sign of tuberculosis elsewhere.

SUMMARY.

With the object of ascertaining whether tubercle bacilli are excreted in the milk from a normal udder, four cows and seven goats which had not reacted to the tuberculin test were inoculated with culture of such bacilli and their milk tested subsequently on guinea-pigs. Three cows and five goats were inoculated subcutaneously (one of the cows being subsequently inoculated intravenously), one cow and one goat intravenously, and one goat was fed.

The first cow, Cow 300, was inoculated subcutaneously with 100·0 mg. of tubercle bacilli of bovine origin; the milk withdrawn by hand on the seventh, sixteenth, twenty-first, twenty-eighth, and thirtieth days after the inoculation of the cow produced tuberculosis in guinea-pigs.

The second cow, Cow 77, was inoculated subcutaneously with 100·0 mg. of a culture of human origin which was slightly virulent for the calf and rabbit; the milk withdrawn by hand twenty-four hours after the inoculation of the cow produced tuberculosis in four of the eight guinea-pigs inoculated, and tuberculosis was produced with two exceptions on every subsequent occasion, including the last, on which the milk was tested; the last series of guinea-pigs was inoculated after the experiment had lasted 155 days.

The udders of these two cows were normal to the naked eye at the post-mortem examination, and showed no tuberculous lesions or tubercle bacilli on microscopical examination.

The third cow, Cow 61, was also inoculated subcutaneously with 100·0 mg. of a culture of human tubercle bacilli; the samples of milk were collected by catheterisation; guinea-pigs were inoculated at intervals of twenty-four hours during the first week and at gradually lengthening intervals subsequently, the last series 84 days after the cow was inoculated. Altogether 76 guinea-pigs were inoculated, and out of these one only developed tuberculosis.

Ninety days after the subcutaneous inoculation this cow was inoculated intravenously with 150·0 mg. of a slightly virulent culture (Virus H 83. "G.C."). During the first fifteen days of the renewed experiment nine series of guinea-pigs were inoculated at intervals of one or two days; in the first two series (1st and 2nd day's milk) all the guinea-pigs, fourteen in number, developed tuberculosis; and the milk continued to be infective up to the forty-fourth day when the routine inoculation of guinea-pigs was discontinued on account of the cow's udder becoming 'dry.'

About five and a half months after the intravenous inoculation of the cow some pus was obtained from the two fore quarters, and this on microscopical examination was found to contain very numerous tubercle bacilli; subsequently tubercle bacilli were demonstrated from the other quarters also.

Two and a half months later it was noticed that three of the quarters had become enlarged and indurated and that a large amount of purulent substance which microscopically contained numerous tubercle bacilli had collected in the sinuses.

The udder decreased in size and the discharge of pus rapidly diminished, a few drops only being obtained at intervals during the remaining period of the experiment. Tubercle bacilli were demonstrated on every occasion.

Cultures were obtained direct from the pus on four different occasions, the last one day before the cow was killed; these cultures were identical in their cultural characters and in their virulence for the rabbit with the culture intravenously inoculated.

The cow was killed 529 days after the intravenous inoculation, and 619 days after the subcutaneous inoculation; she showed slight generalised tuberculosis and tuberculosis of the udder.

The faeces of this cow were inoculated into 16 guinea-pigs, six after her subcutaneous inoculation and ten after her intravenous; 7 died shortly after inoculation, the others survived and when killed one alone was found to be tuberculous; this guinea-pig had been inoculated 10 days after the intravenous inoculation of the cow.

The fourth cow, Cow 565, was inoculated intravenously with 10·0 milligrammes of a culture of human tubercle bacilli (H 104. "E.R."). Her milk was tested on guinea-

pigs eight times during the first fortnight and 11 times during the remaining period of the experiment (168 days). The milk collected 24 hours, 5, 6, 7, and 14 days after inoculation produced tuberculosis in from one to four of the six guinea-pigs inoculated on each occasion; milk collected subsequent to the 14th day did not produce tuberculosis in any of the guinea-pigs inoculated. 153 days after inoculation the cow gave birth to a dead 8 months old calf; the fluid which came away with it was purulent and contained numerous tubercle bacilli; the spleen and a portal gland of the foetus did not produce tuberculosis in guinea-pigs. The cow was killed after 182 days and showed no tuberculous lesions.

One of the goats, Goat 79, was inoculated subcutaneously with 50·0 milligrammes of a bovine culture from a case of lupus and was killed 9 days later. The milk of the goat was inoculated into guinea-pigs at frequent intervals; that withdrawn from the right half of the udder on the 2nd, 3rd, 4th, and 9th days was infective for guinea-pigs, that from the left side produced tuberculosis in only one of the guinea-pigs inoculated.

Another goat, No. 55, was subcutaneously inoculated with 50·0 mg. of a eugonic culture which was shown subsequently to contain a small proportion of virulent tubercle bacilli. Milk collected at intervals of 24 hours during the first eight days, and on the 14th, 21st, and 75th day, produced tuberculosis in guinea-pigs. At the post-mortem examination of the goat several miliary tubercles were found in the left half of the udder and a caseating patch in the right. Two cultures isolated from the milk of this goat were eugonic and one has been proved to have low virulence for the rabbit.

The third goat, No. 59, was inoculated subcutaneously with 100·0 mg. of a slightly virulent culture. All the guinea-pigs, twenty in number, inoculated with her milk during the first six days became tuberculous. At the post-mortem examination the udder of the goat was normal to the naked eye.

The fourth goat, No. 69, was inoculated subcutaneously with 10·0 mg. of a human tubercle bacillus. Her milk was not infective for the guinea-pigs inoculated during the first week but produced tuberculosis in every guinea-pig inoculated on the 14th day and subsequently. Tuberculosis of her mamma developed on the 42nd day after inoculation. Cultures isolated at various times from her milk resembled the culture inoculated.

The 5th goat, Goat 81, was inoculated intravenously with 2·0 milligrammes of a culture of human tubercle bacilli; she died in 41 days of tuberculosis of the lungs and thoracic glands, no disease being found elsewhere in the body. Milk withdrawn from her on the 1st, 2nd, 3rd, 8th and 15th days, and the fluid recovered from the mammary sinuses on the 41st day after injecting saline solution produced tuberculosis in guinea-pigs.

A sixth goat, Goat 61, was inoculated subcutaneously with 1·0 milligramme, and a seventh (No. 75) was fed with 74·0 milligrammes, of culture, the culture in each case being slightly virulent and easy-growing. The milk of each of these goats was inoculated at intervals into a series of guinea-pigs, 13 series in one case and 11 in the other being used. Not one of the guinea-pigs became tuberculous. These are the only two out of eleven experiments in which the results were entirely negative.

The other nine experiments have shown clearly that the normal mammary gland will permit the escape of tubercle bacilli whether of bovine or of human type from the blood-stream into the milk.

There arises, therefore, strong presumption that the milk of naturally tuberculous cows without udder tuberculosis will contain tubercle bacilli whenever in the course of the disease tubercle bacilli circulate in the blood stream.

A. STANLEY GRIFFITH.

TABULAR SUMMARY OF THE EXPERIMENTS.

Reference Letter of Experiment.	Number and Species of Animal.	Dose of Culture.	Method of Inoculation.	Type of Bacillus.	Duration of Life of Animal and Result.	Guinea-pig Inoculations with the Milk.			Remarks.
						Positive Results first obtained.	Results subsequently obtained.		
							Positive.	Negative.	
A.	Cow 300	100.0 mg.	Subcutaneous	Bovine (Virus B. VI.)	Died in 30 days (acute tuberculosis).	On the 7th day (1st test).	On the 16th, 21st, 28th, and 30th days.	—	
B.	Cow 77	100.0 mg.	Subcutaneous	Human. Group II. (Virus H 68. "R.B.")	Killed after 156 days (local tuberculosis).	On the 1st day	On all subsequent occasions (with two exceptions) from the 2nd to the 155th day.	On the 5th and 28th days.	
C.	Cow 61	100.0 mg.	Subcutaneous	Human. Group II. (Virus H 81. "P.W.")	—	On the 7th day (3rd test).	—	On the 14th, 35th, 42nd, 63rd, 67th, and 84th days.	One guinea-pig only out of 76 developed tuberculosis.
	Cow 61 [Reinoculated after 90 days.]	150.0 mg.	Intravenous	Human. Group II. (Virus H 83. "G.C.")	Killed after 529 days (slight generalised T. and T. of mamma).	On the 1st day	On the 2nd, 3rd, 5th, 7th, 8th, 10th, 12th, 15th, and 44th days, and with pus on the 163rd and 528th days.	On the 83th day (one guinea-pig only inoculated, with a small dose).	The udder became dry in the 2nd month after inoculation. Subsequently tuberculous mastitis developed and numerous T.B. were demonstrated microscopically at intervals from the 162nd to the 528th day in pus obtained from the milk sinuses.
D.	Cow 565	10.0 mg.	Intravenous	Human. Group II. (Virus H 104. "E.R.")	Killed after 182 days (no tuberculosis).	On the 1st day	On the 5th, 6th, 7th, and 14th days.	On the 2nd, 3rd, 4th, 28th, 42nd, 63rd, 77th, 105th, 133rd, 168th, 175th, 177th, 179th, and 182nd days.	The cow gave birth to a dead calf (8 months) 153 days after her inoculation, and the fluid which came away with it contained numerous T.B.

E.	Goat 79	50.0 mg.	Subcutaneous	Human. Group I. (Virus H 110. "J.B." (a).)	Killed after 9 days (local T. and T. of lungs).	On the 2nd day (2nd test; right side of udder only).	On the 3rd, 4th, and 9th days (right side), and on the 3rd day (left side).	On the 1st day (both sides) and on the 4th, 5th, 6th, and 9th days (left side only).	The milk secretion had practically ceased on the 9th day.
F.	Goat 55	50.0 mg.	Subcutaneous	Human. Groups I and II (mixture). (Virus H 90. "I.P.")	Killed after 103 days (slight gene- ralised T. and T. of mamma).	On the 1st day	On all occasions from the 2nd to the 75th day.	—	The secretion of milk ceased in the 2nd week after inocula- tion.
G.	Goat 59	100.0 mg.	Subcutaneous	Human. Group II. (Virus H 79. "J.N.")	Killed after 106 days (slight gene- ralised tubercu- losis).	On the 1st day	On the 2nd, 4th, 5th, and 6th days.	—	The udder became dry during the 2nd month. Cultures were obtained from milky fluid taken from sinuses after death.
H.	Goat 69	10.0 mg.	Subcutaneous	Human. Group II. (Virus H 98. "B.R.")	Killed after 114 days (local T. and miliary T. of mamma).	On the 14th day (6th test).	On the 21st, 28th, and 44th days.	—	
I.	Goat 61	1.0 mg.	Subcutaneous	Human. Group II. (Virus H 109. "M.W.")	Killed after 197 days (local lesion only).	The milk was tested frequently from the 1st up to the 197th day with negative results.			
J.	Goat 81	2.0 mg.	Intravenous	Human. Group II. (Virus H 115. "N.G.")	Died in 41 days (T. of lungs and thoracic glands).	On the 1st day	On the 2nd, 3rd, 8th, 15th, and 41st days.	—	
K.	Goat 75	74.0 mg.	Fed	Human. Group II. (Virus H 76. "G.M.")	Killed after 328 days (local tuber- culosis only).	The milk was tested frequently from the 1st to the 45th day, and again on the 258th day, with negative results.			Gave birth to two kids 250 days after inocu- tion. They sucked their mother, and when killed after 72 days were found healthy.

Part II.

THE EXCRETION OF TUBERCLE BACILLI INTO THE UNDEVELOPED UDDER.

INTRODUCTION.

THE foregoing experiments demonstrate that when lactating animals are inoculated subcutaneously or intravenously with tubercle bacilli of relatively slight virulence such bacilli appear in their milk within 24 hours of their inoculation and may continue to be eliminated therein for long periods subsequently.

This immediate discharge into and persistence in the milk sinuses of tubercle bacilli which have been introduced into the tissues of an animal renders the vaccination of milch cows with living human tubercle bacilli inadvisable; cows treated in this way might prove even more dangerous to human health than naturally tuberculous cows since, as the above experiments have shown, the bacilli may exist in the milk sinuses for a long time without altering the quality of the milk or affecting the udder or the general health of the animal.

The vaccination of the bovine animal with living human tubercle bacilli is practised however only on calves and not on animals in use for dairy purposes.

It becomes important therefore to ascertain whether the vaccination of calves intended eventually to supply milk for human consumption is free from the danger which would attend the vaccination of milch cows, whether in fact tubercle bacilli can gain access to the sinuses of the immature mamma, live and multiply therein, and be present in the milk when the animal begins to lactate.

With a view to throwing some light on these questions I have examined the contents of the mammary sinuses of several heifer calves which had been inoculated to test the virulence of various sorts of cultures, and the milk of a goat which was inoculated when pregnant has also been tested.

Observations have been made on eleven heifer calves, all of which had been inoculated subcutaneously with culture. Two of these cultures had the properties of the human tubercle bacillus, one those of the bovine tubercle bacillus, the others resembled bovine tubercle bacilli in their manner of growth, but exhibited lower virulence for the calf and rabbit. All the eleven calves were in good condition when killed and had increased normally in weight; the disease produced ranged from tuberculosis limited practically to the site of inoculation and the nearest glands to generalised tuberculosis not severe and only apparently progressive in one case.

The material investigated was obtained after the death of the animal in the following way: the skin and teats were thoroughly cleansed and a few cubic centimetres of sterilised salt solution (up to 10·0 cc.) were injected into each of the mammary sinuses, and after massaging the quarter as much of the fluid as possible was withdrawn by means of the pipette used for the injection; the fluid recovered was usually only slightly milky or turbid, and was always less in amount than that injected.

The following summaries give in the case of each calf the details of the experimental inoculation, an abstract of the post-mortem notes and the results of the investigation of the fluids from the mammary sinuses. I include an account of a case, a heifer (No. 80) inoculated with bovine tubercle bacilli, the details of which have already been reported in the Appendix to the Second Interim Report, Vol. I., pp. 198, 199.

The ages of the calves when killed varied from six to ten months, and the duration

of the experiments from 91 to 127 days; the heifer inoculated with bovine tubercle bacilli was 18 months old, and when killed was five months pregnant.

Case 1. A heifer-calf (Calf 1479) inoculated subcutaneously when six months old with 100.0 milligrammes of culture from Virus H 79. "J.N." (Calf 1325, 3rd passage). The cultures of this virus grow luxuriantly on artificial media and have low virulence for the calf and rabbit.

The calf was killed 110 days after inoculation and showed a caseous abscess at the seat of inoculation, slight tuberculosis of the nearest gland, and calcareous tubercles in the suprarenal bodies, the thoracic glands, the mesenteric, ileo-colic and a few other abdominal lymphatic glands.

The mamma was small and free from visible tuberculous lesions; the fluid recovered from the sinuses after injecting saline was small in amount and opalescent. No tubercle bacilli were demonstrated in smear preparations of the fluid, but four guinea-pigs inoculated two with the mixed fluids from the fore quarters and two with the fluids from the hind quarters became tuberculous.

Cultures of the tubercle bacillus were obtained direct from the fluids, numerous colonies developing on tubes sown with a loopful or two; the cultures exhibited the cultural characters of the original cultures of the virus.

Case 2. A heifer-calf (Calf 1601) inoculated subcutaneously when 4 months old with 68.0 milligrammes of culture from the original material of Virus H 143. "L.L."

The calf was killed 91 days after inoculation and showed a caseous abscess at the seat of inoculation, tuberculosis of the nearest glands, a few minute tubercles in the lungs, some caseous foci in the ileo-colic glands and about fifteen miliary caseous tubercles in the suprarenal bodies.

The mamma was free from macroscopic tuberculous lesions. Slightly turbid fluid was recovered from each of the sinuses after injecting saline solution. One or two tubercle bacilli were seen in smear preparations of fluid from each of three of the quarters, none in that from the fourth; the fluid from each of the four quarters produced numerous colonies on culture tubes, and tuberculosis in guinea-pigs.

Case 3. A heifer-calf (Calf 1461) inoculated subcutaneously when six months old with 50.0 milligrammes of culture from Virus H 53. "D.H." (a) (Calf 1367, 3rd passage).

The calf was killed 111 days after inoculation and showed a caseous local lesion, tuberculosis of the nearest glands, a few scattered calcareous foci in the thoracic glands, and three softened caseous tubercles in a mammary lymphatic gland.

The mamma was well-developed and no tuberculous lesions were found in it. There was a small quantity of opalescent fluid in each of the sinuses which in one case showed microscopically moderately numerous tubercle bacilli. A culture of tubercle bacilli was obtained direct from the fluid, and one guinea-pig inoculated with a few drops developed tuberculosis.

Case 4. A heifer-calf (Calf 1535) inoculated subcutaneously when about three months old with 50.0 milligrammes of culture from the original material of Virus H 53. "D.H." (b).

The calf was killed when in good health 103 days after inoculation and showed a local abscess, tuberculosis of the adjacent gland, scattered calcareous tubercles in the lungs and the spleen, tuberculous foci and ulcers in the intestines and caseous or calcareous tubercles in nearly every lymphatic gland.

No tubercles were found in the tissue of the mammary gland. In the sinuses and ducts of the right fore quarter there was a small quantity of purulent fluid which microscopically showed tubercle bacilli; from the other quarters slightly milky fluid was obtained after injecting saline; no tubercle bacilli were found in smear preparations of this fluid.

A guinea-pig inoculated with the pus from the right fore quarter died of severe general tuberculosis; those inoculated with the milky fluid recovered from the left fore and right hind quarters remained healthy.

A pure culture of the tubercle bacillus was obtained from the pus; tubes sown with the milky fluids remained sterile. The culture grew on the differential media like the culture inoculated into the calf.

Case 5. A heifer-calf (Calf 1571) inoculated subcutaneously when 3½ months old with 50.0 milligrammes of culture from Virus H 53. "D.H." (b) (Calf 1561, 1st passage).

The calf was killed 111 days after inoculation and showed a small caseous abscess at the seat of inoculation, tuberculosis of the nearest glands, three tubercles in the spleen, a caseous nodule in a suprarenal body and one or more minute foci in each of seven lymphatic glands.

The mamma was normal to the naked eye; the sinuses were washed out with saline and a small quantity of very slightly turbid fluid recovered from each. Microscopical examinations and guinea-pig inoculations of these fluids gave negative results, and culture tubes sown with them remained sterile.

Case 6. A heifer-calf (Calf 1505) inoculated subcutaneously when five months old with 100.0 milligrammes of culture from Virus H 107. "H.H." (Calf 1453).

The calf was in good health when killed 101 days after inoculation. The post-mortem examination showed a small local lesion, caseo-calcareous changes in the nearest glands and some ulcerated tuberculous nodules in the intestines; there was no sign of tuberculosis elsewhere, and the mamma was normal to the naked eye.

The mammary sinuses were washed out with saline, and the slightly turbid fluid recovered was used to sow cultures and inoculate guinea-pigs. The results were negative. No tubercle bacilli were found in smear preparations of the fluid.

Case 7. A heifer-calf (Calf 1549) inoculated subcutaneously when 2½ months old with 50.0 milligrammes of culture from Virus H 107. "H.H." (Calf 1497).

The calf was killed in good health 97 days after inoculation, and was found to have slight general tuberculosis, apparently progressive in the thoracic glands. The mamma was well-developed, and was free from macroscopic tuberculosis; many of the lactiferous ducts contained plugs of purulent substance.

The mammary sinuses were washed out with saline, the recovered fluids depositing pus in the form of casts. Tubercle bacilli were found in smear preparations, and numerous colonies grew on culture media sown from the mixed fluids from the fore quarters and the mixed fluids from the hind quarters. No guinea-pigs were inoculated.

Case 8. A heifer-calf (Calf 1577) inoculated subcutaneously when 3½ months old with 50.0 milligrammes of culture from Virus H 107. "H.H." (Calf 1551, 2nd Passage).

The calf was killed 103 days after inoculation and showed a caseo-purulent abscess at the seat of inoculation, caseation of the adjacent glands, one tubercle in each suprarenal body and one or more minute foci in the thoracic and three abdominal glands.

- The mamma was normal to the naked-eye; the sinuses were washed out with saline; the fluid recovered was in each case very slightly turbid. Microscopical examinations and guinea-pig inoculations of these fluids gave negative results, and culture tubes sown with them remained sterile.
- Case 9.* A heifer-calf (Calf 1583) inoculated subcutaneously when 11 weeks old with 50.0 milligrammes of culture from Virus H 107. "H.H." (Calf 1549, 1st Passage.)
- The calf was killed 127 days after inoculation and showed a small abscess at the seat of inoculation, caseous and calcareous nodules in the adjacent prescapular gland, a minute focus in one suprarenal body, and one or more foci, mostly minute, in the thoracic and two or three abdominal glands.
- The udder was small and showed very little glandular tissue; the sinuses were washed out with saline. Microscopical examination of the fluids recovered from the sinuses showed no tubercle bacilli, guinea-pigs inoculated with the fluids remained healthy, and culture tubes sown with them sterile.
- Case 10.* A heifer-calf (Calf 1533) inoculated subcutaneously when four months old with 50.0 milligrammes of culture from Virus H 108. "H.R." (Calf 1417).
- The calf was killed in good health 98 days after the inoculation and was found to have widespread generalised tuberculosis; all the lymphatic glands were affected some rather severely, but in the chief organs the lesions were not very numerous, and all had retrogressive characters.
- The mamma was free from macroscopic tuberculous lesions. A small quantity of slightly turbid fluid was recovered from each of the sinuses after injecting saline. The mixed fluids from the two fore quarters and the mixed fluids from the two hind quarters were each used to inoculate a guinea-pig and to sow cultures.
- The guinea-pig inoculated with the fluid from the fore quarters became tuberculous, the other remained healthy.
- Two egg tubes sown with the fluid from the fore quarters produced altogether eight colonies of tubercle bacilli; those sown from the hind quarters remained sterile.
- Case 11.* A heifer (Heifer 80) inoculated subcutaneously when about 18 months old with an emulsion made from a bovine tuberculous gland (Virus B. V) the dose containing 4½ million tubercle bacilli. The full details of this case are given in the Appendix to the 2nd Interim Report, Vol. I., p. 193.
- The heifer was killed 62 days after inoculation and showed slight generalised tuberculosis; there was a five months old foetus in the uterus which was not tuberculous; the mammary tissues showed no naked-eye evidence of tuberculosis and the milk sinuses contained a small quantity of thick yellowish fluid; no tubercle bacilli were demonstrated in a smear preparation made from the fluid, but a guinea-pig inoculated with it died of general tuberculosis.
- Case 12.* A heifer-calf (Calf 1569) inoculated subcutaneously when 3 months old with 50.0 milligrammes of culture from the original material of Virus H 127. "R.R." (a).
- The calf was killed when in good health 105 days after inoculation and showed slight general tuberculosis apparently retrogressive.
- The mamma appeared normal (the supramammary lymphatic glands were normal). Thin grey purulent fluid was expressed from the teats of three of the quarters; these fluids showed tubercle bacilli on microscopical examination, and produced numerous colonies on culture tubes sown with them. From the remaining quarter (L.H.) no pus could be expressed; the sinus was washed out with salt solution; microscopical examination of the recovered fluid showed no tubercle bacilli and culture tubes sown with it remained sterile.
- Case 13.* Goat 77, a young pregnant primipara, was inoculated subcutaneously with 25.0 milligrammes of a human Group II culture obtained from sputum (Virus H 118. "F.C.").
- This experiment was made for the purpose of ascertaining whether tubercle bacilli can pass from the blood into the milk sinuses of an immature mamma and remain alive therein until the animal begins to lactate. The experiment had a negative result.
- The goat gave birth to two dead full-time foetuses 52 days after inoculation. The udder was well-developed and yielded a good supply of milk. Guinea-pigs were inoculated with milk withdrawn 8 hours, 1, 2, 8, 14, 28, and 59 days after the birth of the kids, and all remained free from tuberculosis. Microscopical examinations and culture experiments were also negative.

SUMMARY.

In seven out of eleven heifers tubercle bacilli of various types which had been inoculated in large dose into the subcutaneous tissues had found their way into the milk sinuses of the undeveloped mamma, and in four cases at least (Calves 1461, 1535, 1569, and 1601) were present in such numbers as to suggest that since their arrival there they had undergone multiplication.

These observations clearly establish the important fact that tubercle bacilli which have been introduced into the subcutaneous tissues of a calf can find their way into the ducts and milk sinuses of the immature mamma, and suggest that they may live and multiply therein for considerable periods.

Whether the bacilli in these cases would have remained alive until the period of lactation is a matter of conjecture, but judging from the length of time bacilli have been shown to be capable of living in the milk sinuses of cows there is reasonable probability that the first milk of some of these animals would have contained living tubercle bacilli.

Though there is not complete evidence that bacilli excreted into the milk sinuses of the immature udder do remain alive therein until the period of lactation begins, the facts established point strongly to the desirability of testing, before permitting its use as human food, the milk of all cows which have been vaccinated as calves with living human tubercle bacilli.

**TABULAR SUMMARY OF THE EXPERIMENTS WITH MATERIAL OBTAINED FROM THE MAMMARY SINUSES OF TWELVE HEIFERS AND ONE GOAT
SUBCUTANEOUSLY INOCULATED WITH CULTURES OF TUBERCLE BACILLI OF HUMAN (AND ONE OF BOVINE) ORIGIN.**

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Number of Case.	Number of Animal and Age at Inoculation.	Dose in Milli-grammes.	Type of Bacillus Inoculated.	Duration of Life of Animal.	Extent of Disease.	Results of Examination of Material from Mammary Sinuses.			
						Source of Material.	Microscopical Examination.	Guinea-pig Inoculations.	Cultures.
1	Heifer 1479 (6 months).	100.0 mg.	Human. Group II. (Virus H 79. "J.N.")	Killed after 110 days.	Slight generalised retrogressive T. (mammary normal).	Two fore quarters Two hind quarters	No T. B. No T. B.	Positive Positive	Moderately numerous colonies. Moderately numerous colonies.
2	Heifer 1601 (4 months).	68.0 mg.	Human. Group II. (Virus H 143. "L.L.")	Killed after 91 days.	Local T. with a few disseminated lesions (mammary normal).	Right fore quarter Left fore quarter Right hind quarter Left hind quarter	A few T. B. A few T. B. A few T. B. No T. B.	Positive Positive Positive Positive	Numerous colonies. Numerous colonies. Numerous colonies. Numerous colonies.
3	Heifer 1461 (6 months).	50.0 mg.	Attenuated bovine (H 53. "D.H." (a))	Killed after 111 days.	Local T. with a few disseminated lesions (mammary normal).	One of the quarters	A moderate number of T. B.	Positive	Moderately numerous colonies.
4	Heifer 1535 (3 months).	50.0 mg.	Attenuated bovine (H 53. "D.H." (b))	Killed after 103 days.	Slight generalised T. (mammary normal).	Right fore quarter Left fore quarter Right hind quarter Left hind quarter	A few T. B. — No T. B. No T. B.	Positive Negative Negative —	Numerous colonies. Tubes remained sterile. Tubes remained sterile. Tubes remained sterile.
5	Heifer 1571 (3½ months).	50.0 mg.	Attenuated bovine (H 53. "D.H." (b))	Killed after 111 days.	Local T. with a few disseminated lesions (mammary normal).	Right fore quarter Left fore quarter Right hind quarter Left hind quarter	No T. B.	Negative	Tubes remained sterile
6	Heifer 1505 (5 months).	100.0 mg.	Attenuated bovine (H 107. "H.H.")	Killed after 101 days.	Local T. with a few disseminated lesions (mammary normal).	Two fore quarters Two hind quarters	No T. B. No T. B.	Negative Negative	Tubes remained sterile. Tubes remained sterile.
7	Heifer 1549 (10 weeks).	50.0 mg.	Attenuated bovine (H 107. "H.H.")	Killed after 97 days.	Slight G. T. apparently progressive in thoracic glands (mammary normal).	Two fore quarters Two hind quarters	A few T. B. A few T. B.	— —	Moderately numerous colonies. Moderately numerous colonies.
8	Heifer 1577 (3½ months).	50.0 mg.	Attenuated bovine (H 107. "H.H.")	Killed after 103 days.	Local T. with a few disseminated lesions (mammary normal).	Right fore quarter Left fore quarter Right hind quarter Left hind quarter	No T. B.	Negative	Tubes remained sterile.

TABULAR SUMMARY OF THE EXPERIMENTS WITH MATERIAL OBTAINED FROM THE MAMMARY SINUSES OF TWELVE HEIFERS AND ONE GOAT
SUBCUTANEOUSLY INOCULATED WITH CULTURES OF TUBERCLE BACILLI OF HUMAN (AND ONE OF BOVINE) ORIGIN.

Number of Case.	Number of Animal and Age at inoculation.	Dose in Milli-grammes.	Type of Bacillus Inoculated.	Duration of Life of Animal.	Extent of Disease.	Results of Examination of Material from Mammary Sinuses.			
						Source of Material.	Microscopical Examination.	Guinea-pig Inoculations.	Cultures.
9	Heifer 1583 (2½ months).	50·0 mg.	Attenuated bovine (H 107. "H.H.")	Killed after 127 days.	Local T. with a few disseminated lesions (mammary normal).	Right fore quarter Left fore quarter Right hind quarter Left hind quarter Two fore quarters Two hind quarters	No. T. B.	Negative	Tubes remained sterile.
10	Heifer 1533 (4 months).	50·0 mg.	Attenuated bovine (H 108. "H.R.")	Killed after 98 days.	Slight retrogressive generalised T. (mammary normal).	Two fore quarters	No T. B.	Positive	Eight colonies on two tubes.
11	Heifer 80 (18 months).	Tissue emulsion; estimated dose 4,500,000 T. B.	Bovine (Virus B V).	Killed after 62 days.	Slight general progressive T. (mammary normal).	One of the quarters	No T. B.	Negative	Tubes remained sterile.
12	Heifer 1569 (3 months).	50·0 mg.	Bovine. (Virus H 127. "R.R." (a))	Killed after 105 days.	Slight G. T. apparently retrogressive (mammary normal).	Right fore quarter Left fore quarter Right hind quarter Left hind quarter	A few T. B. A few T. B. A few T. B. No. T. B.	— — — —	Numerous colonies. Numerous colonies. Numerous colonies. Tubes remained sterile.
13	Goat 77 (Young adult).	25·0 mg.	Human. Group II. (H 118. "F.C.")	Killed after 116 days.	Local T. and slight T. of lungs (mammary normal).	The goat gave birth to two dead kids 52 days after her inoculation. Her milk was tested on guinea-pigs 8 hours after parturition, and on several occasions subsequently, with negative results. Culture tubes sown with the milk 8 hours after parturition remained sterile.			

DETAILS OF THE EXPERIMENTS DEALT WITH IN PART I. OF THE REPORT.

EXPERIMENT A.

COW 300.

Subcutaneous inoculation of culture derived from a tuberculous mediastinal gland of a cow (Virus B VI.).

Date—September 2, 1905.

Dose—100·0 milligrammes.

Died—October 2, 1905. [30 days after inoculation.]

Clinical History.

The cow was inoculated subcutaneously on the left side of the neck on September 2, 1905.

Four days after inoculation there was a slightly raised tender local swelling, 3 in. in diameter; the prescapular gland was appreciably enlarged. On September 13, 1905, 11 days after inoculation the tumour was more raised, and measured 5 in. by 4 in. in superficial area. Subsequently the tumour became more prominent, but increased in area only to a slight extent.

The prescapular gland enlarged considerably and measured at the end of three weeks 6 in. in long diameter; the spherical prepectoral gland was the size of a bagatelle ball.

Constitutional symptoms were first noticed about the 16th day; the coat was staring and there was some loss of appetite. From this date the progress of the disease was rapid. The respiration became greatly increased and finally laboured, and there was frequent cough and rapid emaciation, the average loss in weight per day being 5·4 lbs.

The cow died suddenly on October 2, 1905, 30 days after inoculation.

Temperature.

The temperature rose gradually from 38·5° C. on the 4th day to 40·7° C. on the 12th; it then maintained a high level, maximum 40·9°, falling on the morning of the day of death to 38·9.

Weights.

There was a steady loss in weight.

		wt.	qrs.	lbs.
September 5, 1905	...	5	1	15
September 12, 1905	...	5	0	21
September 19, 1905	...	4	3	25
September 26, 1905	...	4	1	17
October 2, 1905...	...	4	0	9

Loss in weight.—1 cwt 1 qr. 6 lbs.

Average loss per day.—5·4 lbs.

POST-MORTEM EXAMINATION.

Condition poor.

Local Lesion.—The local lesion weighed 14 ozs. and measured 14 by 7 by 4 cm.; it was composed of caseo-necrotic substance adherent to the skin and muscles.

Left Prescapular Gland.—The left prescapular gland was enlarged (12·5 by 6·8 by 5·5 cm.), and the cortex was caseating throughout.

The Left Prepectoral Gland, the size of a pigeon's egg, was dense and caseous throughout.

The Right Prescapular Gland contained several minute opaque tubercles.

The Cervical Glands on either side contained a few opaque tubercles, varying in size up to a pin's head.

Abdomen.

Diaphragm.—On the peritoneal surface of the diaphragm there were some flattened translucent tubercles with opaque centres.

Spleen.—The spleen weighed 1½ lbs.; the pulp was almost diffuent and contained a moderate number of scattered miliary tubercles.

Liver.—The substance was soft and only a single grey tubercle was seen.

Portal Glands.—In the portal glands no tubercles were visible; they were extremely soft and slightly decomposed.

Gall Bladder.—Normal.

Kidneys.—The left kidney contained five grey tubercles up to a pinhead in size.

The right kidney contained one opaque slightly yellow tubercle.

Suprarenals.—The suprarenal bodies were normal.

Renal Glands.—These contained a few miliary tubercles with opaque centres.

Thorax.

Heart.—Normal.

Pericardium.—The pericardial sac contained a small amount of blood-stained fluid.

Pleura.—On the parietal pleura there were four flattened loosely attached translucent tubercles opaque in the centre, up to 1·5 millimetre in diameter.

Lungs.—The lungs were very emphysematous; large blebs of gas could be seen beneath the pleura extending into and distending the interlobular connective tissue.

The right anterior and middle lobes were red and consolidated. The left anterior lobe was congested, but floated in water. The substance of all the lobes was closely filled with grey miliary tubercles with opaque yellowish centres.

There was considerable emphysema of the tissues in the dorsal mediastinum.

Bronchial Glands, Infra-tracheal Glands.—No tubercles were seen.

Mediastinal Glands.—The dorsal mediastinal glands were extremely soft and discoloured and contained gas. In some of them four or five yellowish miliary tubercles could be seen; in the others no tubercles were visible.

Alimentary Tract.

Pharynx, Larynx.—Normal.

Parotid Glands.—In the left parotid salivary gland there were four opaque pinhead tubercles, and three similar tubercles in the lymphatic gland.

The right parotid salivary and lymphatic glands appeared normal.

The Posterior Pharyngeal Glands were congested and contained numerous minute opaque foci.

Intestines.—Normal.

The Mesenteric Glands were soft and oedematous and a few minute opaque tubercles could be seen in each.

Mamma.—Normal in appearance.

Various Lymphatic Glands.

The Gluteal, Ischiatic, Popliteal, Axillary, Submaxillary, Lumbar, Iliac, Precural, Supramammary, Sacro-Iliac, and Celiac glands contained each a few opaque yellowish tubercles, varying in size up to that of a pin's head.

Microscopical Examination.

Liver (grey tubercle).—A few tubercle bacilli.

Udder.—No tubercle bacilli.

<i>Mesenteric Gland</i>	} Moderate numbers of tubercle bacilli.
<i>Ischiatic Gland</i>	
<i>Thoracic Gland</i>	

Right Bronchial Gland.—Numerous tubercle bacilli.

LIST OF GUINEA-PIGS INOCULATED WITH MILK OF COW 300.

DOSE OF MILK IN EACH CASE: 5 cc. (NOT CENTRIFUGALISED).

Date.	Number of Guinea-pig and Quarter of udder.	Duration of Life in Days.		Killed or Died.	Result.
		Intraperitoneal.	Subcutaneous.		
September 1st, 1905 [Before inoculation of Cow].	1660 } R.F.	36	39	K	Healthy.
	1661 } R.F.			D	No tuberculosis.
	1662 } L.H.	39	39	K	Healthy.
	1663 } L.H.			K	Healthy.
	1664 } L.F.	39	39	K	Healthy.
	1665 } L.F.			K	Healthy.
	1666 } R.H.	39	39	K	Healthy.
	1667 } R.H.			K	Healthy.
September 9, 1905 [7 days after inoculation].	1681 } R.F.	25	41	K	Small local lesion: tuberculosis of inguinal and portal glands (numerous T.B. in both).
	1682 } R.F.			D	No tuberculosis.
	1683 } L.H.	5	41	K	No tuberculosis.
	1684 } L.H.			D	No tuberculosis.
	1685 } L.F.	41	31	D	No tuberculosis.
	1686 } L.F.			K	Tuberculosis of omentum, spleen, liver, and many lymphatic glands: T.B. found in a lumbar gland.
	1687 } R.H.	41	31	D	No tuberculosis.
	1688 } R.H.			K	Small local lesion: minute point in left inguinal gland: sternal gland caseous (T.B.).
September 18, 1905 [16 days after inoculation].	1693 } R.F.	19	7	D	A few T.B. were found in the local lesion: inguinal glands normal.
	1694 } R.F.			D	No tuberculosis.
	1695 } L.H.	7	42	K	No tuberculosis.
	1696 } L.H.			D	No tuberculosis.
	1697 } L.F.	42	42	K	No tuberculosis.
	1698 } L.F.			K	Tuberculosis of omentum, spleen, and liver; many lymphatic glands extensively caseous: T.B. in spleen, omental and portal glands.
	1699 } R.H.	19	42	K	Local lesion: right inguinal and portal glands were caseous: T.B. in portal gland.
	1700 } R.H.			D	No tuberculosis.
September 23, 1905 [21 days after inoculation].	1709 } R.F.	40	38	D	Local ulcer: inguinal, portal, and coeliac glands caseous (T.B.): 3 tubercles in spleen (T.B.).
	1710 } R.F.			D	General tuberculosis.
	1711 } L.H.	73	77	D	General tuberculosis: lungs slightly affected.
	1712 } L.H.			D	General tuberculosis.
	1713 } L.F.	14	70	D	General tuberculosis: lungs only slightly affected.
	1714 } L.F.			D	No tuberculosis.
	1715 } R.H.	79	42	D	Small local lesion: caseation of right deep inguinal and iliac glands (T.B. in both).
	1716 } R.H.			K	No tuberculosis.
September 30, 1905 [28 days after inoculation].	1719 } R.F.	32	62	D	General tuberculosis.
	1720 } R.F.			D	General tuberculosis.
	1721 } L.H.	33	60	D	General tuberculosis.
	1722 } L.H.			D	Slight tuberculosis.
	1723 } L.F.	66	61	D	General tuberculosis: two tubercles in lungs.
	1724 } L.F.			D	General tuberculosis.
	1725 } R.H.	32	32	D	Carcass partly eaten: sternal and right axillary glands were caseous: T.B. in former.
	1726 } R.H.			D	General tuberculosis.
October 2, 1905 [30 days after inoculation].	1727 } R.F.	26	39	D	Slight tuberculosis.
	1728 } R.F.			D	Carcass eaten.
	1729 } L.H.	43	59	D	General tuberculosis: not severe.
	1730 } L.H.			D	General tuberculosis.
	1731 } L.F.	39	57	D	General tuberculosis.
	1732 } L.F.			D	General tuberculosis.
	1733 } R.H.	42	29	D	Carcass eaten.
	1734 } R.H.			D	General tuberculosis.

EXPERIMENT B.

COW 77.

Subcutaneous inoculation of culture derived from a bone abscess (Virus H 68. "R.B").

Dose—100·0 milligrammes.

Date of Inoculation—November 28, 1906.

Weight—7 cwt. 3 qrs 24 lbs.

Killed when in good health—May 3, 1907. [156 days after inoculation.]

Clinical Notes.

Twenty-four hours after inoculation blood from the cow was injected intraperitoneally into a guinea-pig in a dose of 1 cc. The animal showed no sign of tuberculosis when killed 46 days later.

Nine days after inoculation on the left side of the neck there was a slightly raised somewhat flattened tender swelling about 6 cm. in diameter. The left prescapular gland was slightly enlarged, but measurement was not possible on account of fat. The cow was quite well.

Three months later the tumour at the seat of inoculation was represented by a small circular thickening 5 cm. in diameter, with a small dry scab in the centre. The prescapular gland was then apparently normal in size.

The cow remained well during the whole period of the experiment.

Temperature.

The temperature was irregular during the first three weeks, reaching a maximum of 40·0°C. on the sixth day. It was subsequently normal.

Tuberculin Test.

January 31, 1907. [64 days after inoculation.] Reacted. Rise of temperature 1·9°C.

Weights.

The cow was an old animal, and the weight remained stationary during the experiment.

			cwt.	qrs.	lbs.
Nov. 28, 1906	...	...	7	3	24
May 3, 1907	...	...	7	3	20

POST-MORTEM EXAMINATION.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a thickened patch of skin measuring about 5 cm. in area and 1 cm. in thickness; on transverse section this showed in the centre a small pyramidal mass, with the apex near the surface, of pinkish fibroid tissue containing a soft caseo-purulent focus; there was no sign of tuberculosis in the subcutaneous tissues or in the muscles under the thickened patch.

Left Prescapular Gland.—The left prescapular gland measured 5·5 by 3 by 1·5 cm. and showed at one extremity a yellow caseo-purulent nodule about 1 cm. in diameter, containing gritty foci; the rest of the gland was normal.

Right Prescapular Gland.—The gland measured 5 by 3 by 1·5 cm. and was normal on section.

Prepectoral and Axillary Glands.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were crepitant throughout and showed no areas of collapse; under the pleura of the right caudal lobe a spherical grey (?) tubercle (1·5 mm.) with a soft whitish centre was seen; otherwise the lungs were perfectly healthy.

Bronchial and Mediastinal Glands.—Normal.

Heart.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—Normal.

Liver.—The liver showed sparsely scattered throughout its substance small irregular yellow, sometimes greenish yellow, foci.

Portal Glands.—Normal.

Kidneys and Suprarenal Bodies.—Normal.

Renal and Lumbar Glands.—Normal.

The skin on the right side of the abdomen showed a hæmorrhagic abraded area, about 5 cm. in diameter (site of an injury); the subcutaneous tissues under and around this were oedematous.

Iliac and Precrural Glands.—The iliac and precrural glands on the right side were much enlarged; their substance was friable and infiltrated with yellow points and a fine yellow network (? inflammatory).

The glands on the left side were normal.

Supramammary Glands.—The supramammary glands showed in the cortices sparsely scattered yellow points and here and there a yellow network. (The condition was similar to that seen in the iliac and precrural glands but not so advanced.)

Genito-Urinary System.

Uterus.—Normal.

Udder.—The udder with attached skin and glands weighed 13 lbs.; on section the quarters were abnormally tough and showed a marked increase in interstitial connective tissue. The walls of some of the ducts in the right forequarter, which during life was felt to be knotty and indurated, were much increased in thickness, the milk sinuses and ducts containing thick creamy purulent fluid. The left fore-quarter was smaller than the right fore; the walls of some of the ducts appeared thickened; in the anterior part after a longitudinal section a peasized tense grey nodule was seen projecting from the surface; on section this appeared to be a localised dilatation of one of the ducts, with grey fibrous walls and creamy contents (a smear from the contents after long search revealed two tubercle bacilli).

There was no obvious macroscopic evidence of tuberculosis in any of the quarters.

Alimentary Tract.

Tongue, Pharynx, Palate, and Tonsils.—Normal.

Submaxillary, Retropharyngeal, Hyoid, and Parotid Glands.—Normal.

Intestines.—Normal.

Mesenteric, Ileo-colic, and Colic Glands.—Normal.

Various Lymphatic Glands.

Popliteal, Gluteal, and Ischiatic Glands.—Normal.

Microscopical Examination.

Contents of Grey Nodule from L.F. Quarter of Udder.—Two tubercle bacilli seen.

Scraping from Supramammary Gland.—No tubercle bacilli.

Foci from Liver.—No tubercle bacilli.

Lung (? tubercle from).—No tubercle bacilli.

Animals Inoculated.

The following guinea-pigs were inoculated intraperitoneally:—

Emulsion of Spleen.—G.P. 2421.

Emulsion of Liver.—G.P. 2422.

Emulsion of Supramammary Gland.—G.P. 2423.

Emulsion of Left Prescapular Gland.—G.P. 2424.

The first three animals were killed after 91 days and found to be healthy; the latter showed general tuberculosis when killed after 92 days.

GUINEA-PIGS INOCULATED WITH THE MILK OF COW 77.

Date.	Total yield of milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Nov. 28, 1906 [Before inoculation].		2021	Intrap.	L.F.	5 cc.	K.	36 days	Healthy.
		2022	"	L.H.	"	"	"	Healthy.
		2023	"	R.F.	"	"	"	Healthy.
		2024	"	R.H.	"	"	"	Healthy,
Nov. 29, 1906 [24 hours after inoculation].	2350 cc.	2027	Intrap.	L.F.	5 cc.	K.	46 days	No tuberculosis.
		2028	Subcut.	"	"	D.	17 days	Carcass eaten by other guinea-pigs.
		2031	Intrap.	L.H.	"	K.	46 days	No tuberculosis.
		2032	Subcut.	"	"	"	"	No tuberculosis.
		2025	Intrap.	R.F.	"	"	"	(?) tuberculosis of omentum.
		2026	Subcut.	"	"	"	"	Slight tuberculosis.
		2029	Intrap.	R.H.	"	"	"	Slight tuberculosis.
		2030	Subcut.	"	"	"	"	Slight tuberculosis.
Nov. 30, 1906 [2 days after inoculation].	1450 cc.	2049	Intrap.	L.F.	5 cc.	K.	45 days	Slight general tuberculosis.
		2050	Subcut.	"	"	"	"	No tuberculosis.
		2051	Intrap.	L.H.	"	"	"	Slight tuberculosis.
		2052	Subcut.	"	"	"	"	Slight general tuberculosis.
		2047	Intrap.	R.F.	"	"	"	Slight tuberculosis.
		2048	Subcut.	"	"	"	"	Slight tuberculosis.
		2045	Intrap.	R.H.	"	"	"	Slight tuberculosis.
		2046	"	"	"	"	"	General tuberculosis.
Dec. 1, 1906 [3 days after inoculation].	1600 cc.	2057	Intrap.	L.F.	5 cc.	K.	46 days	Slight general tuberculosis.
		2058	Subcut.	"	"	"	"	Slight tuberculosis.
		2059	Intrap.	L.H.	"	"	"	Slight general tuberculosis.
		2060	Subcut.	"	"	"	"	No tuberculosis.
		2053	Intrap.	R.F.	"	"	"	Slight tuberculosis.
		2054	Subcut.	"	"	"	"	Slight tuberculosis.
		2055	Intrap.	R.H.	"	"	"	Slight tuberculosis.
		2056	Subcut.	"	"	"	"	Slight tuberculosis.
Dec. 2, 1906 [4 days after inoculation].	2150 cc.	2065	Intrap.	L.F.	5 cc.	K.	46 days	Very slight tuberculosis.
		2066	Subcut.	"	"	"	"	Slight general tuberculosis.
		2067	Intrap.	L.H.	"	"	"	Slight tuberculosis.
		2068	Subcut.	"	"	"	"	No tuberculosis.
		2069	Intrap.	R.F.	"	"	"	One (?) tubercle in omentum.
		2070	Subcut.	"	"	"	"	No tuberculosis.
		2071	Intrap.	R.H.	"	"	"	Slight general tuberculosis.
		2072	Subcut.	"	"	"	"	No tuberculosis.

GUINEA-PIGS INOCULATED WITH THE MILK OF COW 77—*continued*.

Date.	Total yield of milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Dec. 3, 1906 [5 days after inoculation].	1900 cc.	2073	Intrap.	L.F.	5 cc.	K.	53 days	No tuberculosis.
		2074	Subcut.	"	"	"	"	(?) Slight tuberculosis of inguinal and left iliac glands.
		2075	Intrap.	L.H.	"	"	"	No tuberculosis.
		2076	Subcut.	"	"	"	"	No tuberculosis.
		2077	Intrap.	R.F.	"	"	"	No tuberculosis.
		2078	Subcut.	"	"	"	"	No tuberculosis.
		2079	Intrap.	R.H.	"	"	"	No tuberculosis.
		2080	Subcut.	"	"	"	"	No tuberculosis.
Dec. 4, 1906 [6 days after inoculation].	1850 cc.	2081	Intrap.	L.F.	5 cc.	K.	56 days	General tuberculosis.
		2082	Subcut.	"	"	"	"	No tuberculosis.
		2083	Intrap.	L.H.	"	"	"	No tuberculosis.
		2084	Subcut.	"	"	"	"	General tuberculosis.
		2085	Intrap.	R.F.	"	"	"	General tuberculosis.
		2086	Subcut.	"	"	D.	13 days	Local lesion only. (?) cause of death.
		2087	Intrap.	R.H.	"	K.	56 days	General tuberculosis.
		2088	Subcut.	"	"	"	"	No tuberculosis.
Dec. 5, 1906 [7 days after inoculation].	1800 cc.	2089	Intrap.	L.F.	5 cc.	K.	57 days	Slight general tuberculosis.
		2090	Subcut.	"	"	"	"	No tuberculosis.
		2091	Intrap.	L.H.	"	D.	9 days	Pseudo-tuberculosis.
		2092	Subcut.	"	"	K.	57 days	No tuberculosis.
		2093	Intrap.	R.F.	"	"	"	Slight general tuberculosis.
		2094	Subcut.	"	"	"	"	Slight general tuberculosis.
		2095	Intrap.	R.H.	"	"	"	General tuberculosis, moderately severe.
		2096	Subcut.	"	"	"	"	Slight general tuberculosis.
Dec. 12, 1906 [14 days after inoculation].	—	2109	Intrap.	L.F.	5 cc.	K.	55 days	General tuberculosis.
		2110	Subcut.	"	"	"	"	No tuberculosis.
		2111	Intrap.	L.H.	"	D.	1 day	No sign of disease.
		2112	Subcut.	"	"	K.	55 days	(?) cause of death.
		2113	Intrap.	R.F.	"	"	"	No tuberculosis.
		2114	Subcut.	"	"	"	"	General tuberculosis.
		2115	Intrap.	R.H.	"	"	"	No tuberculosis.
		2116	Subcut.	"	"	"	"	General tuberculosis.
Dec. 19, 1906 [21 days after inoculation].	2600 cc.	2128	Intrap.	L.F.	5 cc.	D.	16 days	No tuberculosis.
		2129	Subcut.	"	"	K.	54 days	Pseudo-tuberculosis.
		2130	Intrap.	L.H.	"	"	"	No tuberculosis.
		2131	Subcut.	"	"	"	"	No tuberculosis.
		2132	Intrap.	R.F.	"	"	"	No tuberculosis.
		2133	Subcut.	"	"	"	"	No tuberculosis.
		2134	Intrap.	R.H.	"	"	"	Slight tuberculosis.
		2135	Subcut.	"	"	"	"	No tuberculosis.

GUINEA-PIGS INOCULATED WITH THE MILK OF COW 77—*continued*.

Date.	Total yield of milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Dec. 26, 1906 [28 days after inoculation].	—	2141	Intrap.	L.F.	5 cc.	K.	58 days	No tuberculosis.
		2142	Subcut.	"	"	"	"	No tuberculosis.
		2143	Intrap.	L.H.	"	"	"	No tuberculosis.
		2144	Subcut.	"	"	"	"	No tuberculosis.
		2145	Intrap.	R.F.	"	"	"	No tuberculosis.
		2146	Subcut.	"	"	"	"	No tuberculosis.
		2147	Intrap.	R.H.	"	"	"	No tuberculosis.
		2148	Subcut.	"	"	"	"	General tuberculosis (spontaneous).
Jan. 9, 1907 [42 days after inoculation].	1457 cc.	2157	Intrap.	L.F.	5 cc.	K.	57 days	No tuberculosis.
		2158	Subcut.	"	"	"	"	No tuberculosis.
		2159	Intrap.	L.H.	"	"	"	No tuberculosis.
		2160	Subcut.	"	"	"	"	No tuberculosis.
		2161	Intrap.	R.F.	"	"	"	No tuberculosis.
		2162	Subcut.	"	"	"	"	Slight general tuberculosis.
		2163	Intrap.	R.H.	"	"	"	No tuberculosis.
		2164	Subcut.	"	"	"	"	No tuberculosis.
Jan. 23, 1907 [56 days after inoculation].	—	2195	Intrap.	L.F.	5 cc.	K.	61 days	No tuberculosis.
		2196	Subcut.	"	"	"	"	No tuberculosis.
		2197	Intrap.	L.H.	"	"	"	No tuberculosis.
		2198	Subcut.	"	"	"	"	No tuberculosis.
		2199	Intrap.	R.F.	"	"	"	Slight general tuberculosis.
		2200	Subcut.	"	"	"	"	No tuberculosis.
		2201	Intrap.	R.H.	"	D.	41 days	General tuberculosis.
		2202	Subcut.	"	"	K.	61 days	No tuberculosis.
Feb. 1, 1907 [65 days after inoculation].	1800 cc.	2216	Intrap.	L.F.	5 cc.	K.	76 days	General tuberculosis.
		2217	Subcut.	"	"	"	"	General tuberculosis.
		2218	Intrap.	L.H.	"	"	"	No tuberculosis.
		2219	Subcut.	"	"	"	"	No tuberculosis.
		2220	Intrap.	R.F.	"	"	"	General tuberculosis.
		2221	Subcut.	"	"	"	"	No tuberculosis.
		2222	Intrap.	R.H.	"	"	"	No tuberculosis.
		2223	Subcut.	"	"	"	"	No tuberculosis.
Feb. 14, 1907 [78 days after inoculation].	—	2251	Intrap.	L.F.	5 cc.	K.	69 days	No tuberculosis.
		2252	Subcut.	"	"	"	"	No tuberculosis.
		2253	Intrap.	L.H.	"	"	"	No tuberculosis.
		2254	Subcut.	"	"	"	"	No tuberculosis.
		2255	Intrap.	R.F.	"	"	"	General tuberculosis.
		2256	Subcut.	"	"	"	"	General tuberculosis.
		2257	Intrap.	R.H.	"	"	"	No tuberculosis.
		2258	Subcut.	"	"	"	"	No tuberculosis.

GUINEA-PIGS INOCULATED WITH THE MILK OF COW 77—*continued*.

Date.	Total yield of milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Feb. 27, 1907 [91 days after inoculation].	1150 cc.	2280	Intrap.	L.F.	5 cc.	K.	68 days	No tuberculosis.
		2281	Subcut.	"	"	"	"	No tuberculosis.
		2282	Intrap.	L.H.	"	"	"	No tuberculosis.
		2283	Subcut.	"	"	"	"	No tuberculosis.
		2284	Intrap.	R.F.	"	"	"	No tuberculosis.
		2285	Subcut.	"	"	"	"	General tuberculosis.
		2286	Intrap.	R.H.	"	"	"	General tuberculosis.
		2287	Subcut.	"	"	"	"	General tuberculosis.
March 20, 1907 [112 days after inoculation].	1360 cc.	2309	Intrap.	L.F.	Each received the centrifuged deposit from 100 cc. of milk.	K.	63 days	No tuberculosis.
		2310	Intrap.	L.H.		"	"	General tuberculosis.
		2311	Intrap.	R.F.		"	"	General tuberculosis.
		2312	Intrap.	R.H.		"	"	General tuberculosis.
		2313	Intrap.	L.F.	5 cc.	"	65 days	No tuberculosis.
		2314	Subcut.	"	"	D.	9 days	No tuberculosis.
		2315	Intrap.	L.H.	"	"	10 days	Slight T. of omentum. Death from pseudo-tuberculosis.
		2316	Subcut.	"	"	K.	65 days	No tuberculosis.
		2317	Intrap.	R.F.	"	"	"	General tuberculosis.
		2318	Subcut.	"	"	"	66 days	General tuberculosis.
		2319	Intrap.	R.H.	"	"	65 days	General tuberculosis.
		2320	Subcut.	"	"	D.	41 days	Slight tuberculosis.
May 2, 1907 [155 days after inoculation].	975 cc.	2402	Intrap.	L.F.	The entire yield of the cow for 24 hours was centrifuged, and the deposit injected.*	K.	63 days	General tuberculosis.
		2403	Intrap.	"		D.	23 days	Pseudo-tuberculosis.
		2404	Subcut.	"		K.	63 days	No tuberculosis.
		2405	Intrap.	L.H.		"	"	No tuberculosis.
		2406	Intrap.	"		"	"	Slight general tuberculosis.
		2407	Subcut.	"		"	"	No tuberculosis.
		2408	Intrap.	R.F.		D.	6 days	No tuberculosis.
		2409	Intrap.	"		K.	53 days	General tuberculosis.
		2410	Subcut.	"		"	"	Slight general tuberculosis.
		2411	Intrap.	R.H.		"	"	No tuberculosis.
		2412	Intrap.	"		"	"	No tuberculosis.
		2413	Subcut.	"		"	"	Slight general tuberculosis.

* The deposit from the milk of each of the four quarters was divided equally among three guinea-pigs.

RABBITS INOCULATED WITH THE MILK OF COW 77.

Date.	No. of Rabbit.	Mode of Injection.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
May 3, 1907 [156 days after inoculation].	1286	Subcut.	Milk from all quarters, mixed.	10 cc.	K.	92 days	Local lesion, and one tubercle in lung.
	1287	Intrap.		,	"	"	Three or four tubercles in omentum, one in a kidney, and one in the lung.

RABBITS INOCULATED WITH EMULSIONS OF TISSUES OF GUINEA-PIGS INJECTED WITH THE MILK OF COW 77.

Date of Injection.	Source of Tissue Emulsion injected.	No. of Rabbit.	Mode of Injection.	Killed or Died.	Duration of Life.	Result.
May 7, 1907	G.P. 2287 (Inguinal Gland).	1288	Subcut.	K.	86 days	Local tuberculosis only.
May 22, 1907	G.P. 2310 (Omentum).	1295	Subcut.	D.	9 days	Death due apparently to local suppuration.
"	G.P. 2311 (Spleen).	1296	Subcut.	K.	119 days	Local lesion and slight tuberculosis of lungs.
"	"	1297	Subcut.	D.	15 days	Local tuberculosis only. Cause of death not determined.
"	G.P. 2312 (Omentum).	1298	Subcut.	K.	91 days	Local tuberculosis and tuberculosis of the lungs.
May 24, 1907	G.P. 2317 (Spleen).	1299	Intrap.	K.	62 days	Very slight tuberculosis of omentum.
"	G.P. 2319 (Spleen).	1300	Intrap.	D.	22 days	Local tuberculosis. Death from pseudo-tuberculosis.
July 4, 1907	G.P. 2413 (Inguinal Gland).	1373	Intrav.	K.	127 days	Slight tuberculosis of lungs.
"	G.P. 2409 (Omentum and Spleen).	1374	Intrav.	K.	127 days	Tuberculosis of lungs.
	"	1375	Subcut.	K.	127 days	Local lesion only.

EXPERIMENT C.

COW 61.

Cow 61 was an old cow, and had lived at Blythwood nearly five years; she had been tested with tuberculin seven times in all, the last test having been made on July 2, 1907. Her last calf was born on October 15, 1905, and for several months the amount of milk yielded from all the quarters had rarely exceeded one-and-a-half pints.

The R.F. quarter had for some time been practically 'dry,' and it had been possible to obtain from it only a small quantity of serous fluid and yellow clots.

First Inoculation—August 6, 1907.

Subcutaneous inoculation of culture derived from the ischiatic gland of Calf 1145 (Virus H 81. "P.W.").

Dose—100.0 milligrammes.

Second Inoculation—November 4, 1907. [90 days after 1st inoculation.]

Intravenous inoculation of culture derived from a human spleen through Guinea-pig 2274, Virus H 83. "G.C."

Dose—150.0 milligrammes.

Killed when in good health—April 16, 1909. [619 days after the first inoculation and 529 days after the 2nd inoculation.]

Tuberculin Tests.

I. October 24, 1907. [79 days after 1st inoculation.] Dose, 3.0 cc. of tuberculin. No reaction. Rise of temperature, 0.2° C.

II. October 30, 1907. [85 days after 1st inoculation.] Dose, 6.0 cc. of tuberculin.

III. February 21, 1908. [109 days after 2nd

inoculation.] Dose, 1.0 cc. of tuberculin. Reacted. Rise of temperature, 1.5° C.

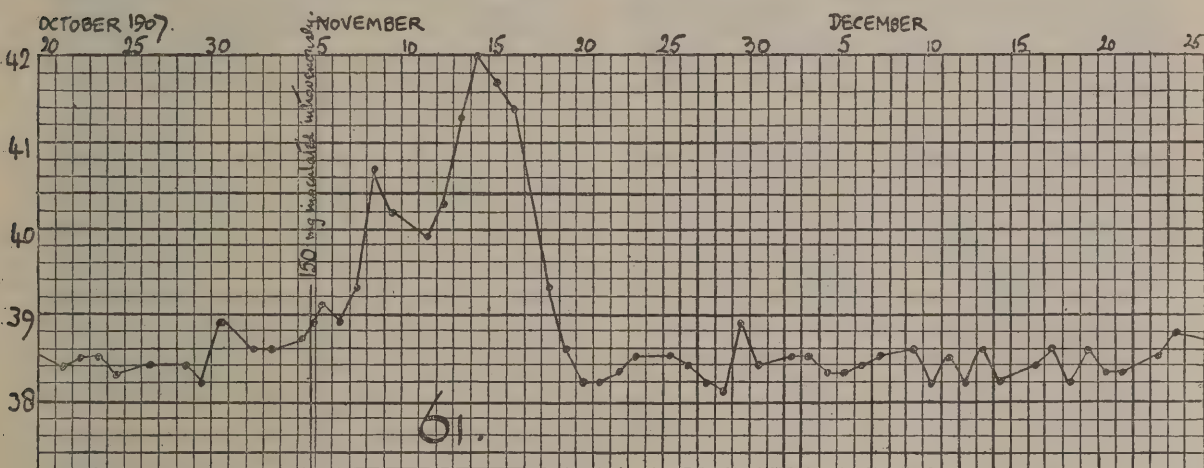
IV. May 20, 1908. [198 days after 2nd inoculation.] Dose, 3.0 cc. of tuberculin. No reaction. Rise of temperature, 0.4° C.

V. November 4, 1908. [366 days after 2nd inoculation.] Dose, 3.0 cc. of tuberculin. No reaction. Rise of temperature, 0.1° C.

Temperature.

The temperature remained normal after the subcutaneous inoculation on August 6, 1907.

Four days after the intravenous inoculation on November 4, 1907, the temperature rose to 40.7° C.; it reached a maximum of 42.0° C. on the 10th day, and then fell rapidly to the normal; the period of pyrexia lasted 12 days. Subsequently (for 17 months) the temperature was normal.



Clinical Notes.

1st Inoculation.—A small hemispherical tumour developed at the site of the subcutaneous inoculation; on October 18 it measured 7 cm. in diameter; the adjacent prescapular gland was not appreciably enlarged.

The cow remained well.

2nd Inoculation.—On November 8, four days after the intravenous inoculation, the cow first appeared to be unwell, and refused her food. On November 11 and 12 she was very ill, the respirations were quick, and the temperature rising (40.3° C.). On November 15 the temperature was very high (41.7° C.), but the cow was much better, and the respirations appeared to be normal.

The cow remained well subsequently.

Microscopical Examinations of Milk and Faeces Subsequent to the Intravenous Inoculation; and Notes on the Condition of the Udder.

On November 5, 24 hours after inoculation, smears from thick mucoid deposit obtained from the R.F.

quarter, and deposit of centrifuged milk from the L.H. quarter, were examined; no tubercle bacilli were seen in either.

On November 6, 48 hours after inoculation, the centrifuged deposit of milk from the L.H. quarter was examined; two or three groups of bodies stained red which resembled tubercle bacilli were seen; another smear showed nothing of a doubtful nature.

No acid-fast bacilli were seen in an emulsion of faeces examined on the same day.

On November 7, 3 days after inoculation, one of the coagula from the R.F. quarter, and one from the L.F. quarter, were examined; chains of streptococci were seen, but no tubercle bacilli. The centrifuged deposit of milk from the L.H. quarter was also examined; no tubercle bacilli were seen. No acid-fast bacilli were seen in an emulsion of the faeces examined on the same day.

On November 9, 5 days after inoculation, the centrifuged deposit (stringy and muco-purulent in character) of mixed milk from the L.F., L.H., and R.H. quarters was examined; no tubercle bacilli were seen.

The centrifuged deposit of mixed milk from the

same quarters was examined two days later with the same result.

On November 12, 8 days after inoculation, some muco-pus from the mixed milk was examined; no tubercle bacilli were seen.

On November 14, 10 days after inoculation, centrifuged deposit of mixed milk from the R.H. and L.H. quarters was examined; no tubercle bacilli were seen. Coagulum from the R.H. quarter was examined with the same result. Two days later a smear from an emulsion of faeces was examined; no tubercle bacilli were seen.

No further microscopical examinations were made during November or December, and in January, 1908, the secretion of milk practically ceased.

On April 14, 1908, 162 days after inoculation, some pus was expressed from the two forequarters of the udder and examined microscopically. It was found to contain very numerous tubercle bacilli and the cells were composed largely of polymorphonuclears with scattered lymphocytes and alveolar cells.

On the following day 50.0 cc. of sterile salt solution were injected into the L.F. quarter and 50.0 cc. into the R.F., and then after manipulating the quarters with the object of flushing out the smaller ducts the fluid was withdrawn into the flasks; not all the fluid was recovered and that which was obtained was slightly milky and contained small flakes and flocculi. Tubercle bacilli were easily found in the fluid. Guinea-pigs and rabbits were inoculated with the fluid (see table).

On April 21, 1908, some pus was expressed from the two hind quarters. Fairly numerous tubercle bacilli were seen in smears, definitely less numerous than in the pus from the fore quarters.

On June 2 drops of pus from the L.F. and the R.F. quarters were again examined; tubercle bacilli were numerous in both.

Towards the end of June it was observed that three of the quarters of the udder had become enlarged and somewhat indurated and that there was a sero-purulent discharge from the two fore teats. A fortnight later there was a distinct increase in the size of the three quarters; the L.F. and L.H. were uniformly indurated, the R.F. was indurated and nodular; the R.H. showed no alteration in size.

On July 1 each of the quarters was milked and altogether 450.0 cc. of yellow tenacious muco-purulent fluid were withdrawn; there was practically none in the R.H. quarter. The fluid contained very numerous tubercle bacilli. [With the exception of a few drops for microscopical examination nothing had been withdrawn from the udder for about six months.]

On July 2 250.0 cc. were withdrawn from the four quarters; and on July 3 only 110.0 cc. were obtained, and this was more serous but very turbid.

On July 17 a few drops of muco-purulent fluid were expressed from each quarter. Tubercle bacilli were numerous in the fluid from three quarters; in that from the R.H. quarter a few clumps of very short tubercle bacilli were seen, quite different from those in the other quarters.

On August 6 pus from the L.F., L.H., and R.F. quarters was microscopically examined. Tubercle bacilli were moderately numerous in the pus from each quarter, but distinctly less numerous than when first examined.

On September 15 pus or fluid was expressed from each of the four quarters and microscopically examined:—

From the L.F. quarter yellowish muco-pus with some small opaque flakes in it was obtained; a smear preparation from it showed a moderate number of tubercle bacilli, moderately numerous in places, and occasionally in clumps.

From the L.H. quarter thick tenacious yellow pus was obtained; a smear preparation showed scattered beaded tubercle bacilli with a few clumps.

From the R.F. quarter yellow muco-pus was obtained; a smear preparation showed scattered beaded tubercle bacilli, mostly single, and a few clumps.

From the R.H. quarter milky watery fluid was obtained; a smear preparation showed a few small groups of very short acid-fast bacilli, some like granules; the cells were chiefly polymorphonuclears.

On October 6 pus or fluid expressed from each of the quarters was microscopically examined:—

In yellow muco-pus from the L.F. quarter a moderate number of tubercle bacilli was seen.

In tenacious yellow pus from the L.H. quarter tubercle bacilli were moderately numerous.

In serous fluid containing small white flakes from the R.F. quarter a moderate number of tubercle bacilli was seen.

In serous fluid from the R.H. quarter one tubercle bacillus was seen.

On October 15, nine days later, milk was obtained from the R.H. quarter; from the other quarters pus was obtained, and this was diluted with saline for microscopical examination and animal inoculation.

The fluid withdrawn from the R.H. quarter was like milk, and on standing a layer of cream separated. In a smear preparation two small groups of acid-fast granules or short bacilli, the majority oval, some almost spherical, were seen, also a good many short chains of cocci. Cells were not numerous and mainly polymorphonuclears; a few alveolar cells and mononuclears were seen.

In the pus from the L.F. quarter tubercle bacilli were moderately numerous; in that from the L.H. a moderate number was seen; in the pus from the R.F. quarter also a moderate number of tubercle bacilli was seen, chiefly in small groups (in the pus from this quarter a calcareous grain was found).

On January 14, 1909, pus or fluid expressed from each of the quarters was microscopically examined:—

In yellow pus from the L.F. quarter moderately numerous tubercle bacilli were seen the majority long and beaded; only about 5.0 cc. of the pus were obtained, it was thick and tenacious and issued from the teat like paint from a tube.

From the L.H. quarter rather less than 1.0 cc. of pus of similar appearance and consistency was obtained; a moderate number of tubercle bacilli was seen in the smear preparation made from it.

In watery fluid with whitish flakes from the R.F. quarter (a few drops only were expressed) scattered tubercle bacilli were seen, much less numerous than in the pus from the L.H. quarter. In turbid watery fluid containing a few flakes of yellow pus from the R.H. quarter (only a few drops were obtained) no tubercle bacilli were seen.

No organisms other than tubercle bacilli were seen in any of the smear preparations.

On April 15, 1909, the milk sinuses of three of the quarters (L.F., R.F., and R.H.) were washed out with normal salt solution. The apparatus used for each quarter was a flask stoppered with a rubber cork containing two glass tubes; one a short one was for the passage of air and was plugged with wool, the other was a long one and extended to the bottom of the flask; to the outer extremity of the long tube was attached by means of semi-pressure tubing a metal catheter which was passed through the teat canal; each flask contained 100.0 cc. of fluid and this was forced into the sinuses by means of an air pump which was fixed on to the air tube.

In the case of the two fore quarters the milk sinuses appeared to be much contracted and it was possible to inject only a small quantity of the fluid at one time, and the fluid recovered was only slightly milky. The right hind quarter took all the saline and the fluid recovered was opaque milky and deposited on standing yellow pus. The teat canal of the left hind quarter was plugged with dry cheesy substance which blocked up the eye of the cannula and on this account the attempt to wash out this quarter was abandoned. The teat canals of each of the other quarters contained yellow pus which was squeezed out before inserting the cannula.

The amount of fluid recovered from each of the three quarters was about 95 cubic centimetres and this was used to inoculate six rabbits intravenously and three guinea-pigs intraperitoneally, two rabbits and one guinea-pig from each quarter; the dose in each case was 4.0 cc. of the fluid.

Microscopical Examinations.

<i>Pus from the teat canals</i>	L.F. Numerous long and beaded tubercle bacilli.
	L.H. A moderate number of tubercle bacilli.
	R.H. No tubercle bacilli.
	A few acid-fast granules.

Watery fluid recovered from the sinuses after the injection of saline.

{	L.F. No tubercle bacilli.
	R.F. A few tubercle bacilli.
	R.H. A few tubercle bacilli, long and beaded.

Since the last note the mamma had undergone appreciable diminution in size; the left fore quarter was still very knotty and indurated, the hind quarters felt uniformly indurated.

The general health of the cow was good.

She was killed the following day, April 16, 1909.

Weights.

			cwt.	qrs.	lbs.
August 6, 1907	...	...	8	2	2
April 16, 1909	...	...	7	1	3

Loss of weight.—1 cwt. 0 qrs. 27 lbs.

POST-MORTEM EXAMINATION.

The carcass was fat.

Seat of Inoculation.—There was no sign of tuberculosis at the seat of the subcutaneous inoculation on the left side of the neck.

Prescapular Glands.—The left prescapular gland measured 6 by 2.5 by 2 cm. and was normal on section. The right measured 6 by 2.5 by 1.5 cm. and was also normal on section.

Thorax.

Lungs—The lungs were crepitant and showed no areas of collapse or consolidation; nothing abnormal was seen from the surface. In the depth of the right caudal lobe towards the posterior extremity there was a dense yellow gritty caseous nodule about 1.2 cm. in diameter, irregular in outline, and formed apparently by two or three nodules aggregated together; in the lung tissue immediately around it were three or four discrete firm caseous nodules the largest the size of a hempseed; adjacent to the above group was a nodule 2 cm. in diameter composed of a number of fibrous-walled cysts filled with tenacious muco-pus. There was also a pea-sized calcareous nodule with fibrous walls.

In the posterior part of the left caudal lobe three hard nodules were found after cutting the lung into thin transverse strips; the largest of these nodules was perhaps 1 cm. in diameter and all showed an irregular calcareous centre and a thick fibrous wall; the calcareous centre (the largest about 5 mm. in greatest diameter) readily shelled out and under a hand-lens showed its surface covered with little excrescences causing it to resemble a piece of coral. Within the fibrous wall of one of the nodules there was a small quantity of yellow pus.

The rest of the lung was normal.

Thoracic Glands.—The long mediastinal gland contained a mass measuring 3.5 by 3 by 1.5 cm. composed of dense canary-yellow caseous areas set in a scanty matrix of fibrous tissue. Elsewhere in the cortex there were two nodules one the size of a pea the other that of a hempseed with caseous centres and fibrous margins.

Other thoracic glands were normal.

Pleura and Heart.—Normal.

Abdomen.

Omentum and Peritoneum, Spleen, Liver, and Kidneys.—Normal.

Pancreas.—In the head of the pancreas there was a mass composed of yellow caseo-purulent nodules set in white fibrous tissue; the largest was rather more than 1 cm. in diameter; towards the middle of the pancreas there were two similar encapsuled caseous and softened nodules; the purulent substance contained calcareous grains.

Suprarenal Bodies.—The left suprarenal body contained altogether about twenty dense yellow gritty caseous nodules the largest 5 mm. in diameter. The right contained ten similar nodules.

Portal, Renal, Lumbar, and Iliac Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils, Intestines and Mesenteric Glands.—Normal.

Genito-Urinary System.

Uterus.—Normal.

Udder.—The udder on the whole was small. The right fore-quarter was much atrophied and was smaller than any of the others; the milk sinuses were almost completely, and the milk ducts completely, obliterated; all that remained of the milk reservoir was a small smooth-walled cavity with short diverticulum, above the root of the teat, and this contained a small quantity of pus; the tissue of the quarter was very dense, and nodules could be felt in various parts of it. On section it was composed of a network of fibrous tissue enclosing light brownish islands of atrophied glandular tissue; in the peripheral parts of the quarter chiefly, *i.e.*, around the margins of the base and the root of the teat, was a number of encapsuled caseo-calcareous nodules, the largest the size of a kidney bean; in the middle of the quarter there were sparsely-scattered caseous gritty nodules the largest the size of a hempseed.

The left fore-quarter was larger than the right but smaller than the two hind quarters, and was very knotty and indurated, the milk sinus except for a small cavity about 2 cm. in length was obliterated; the tissue of the quarter was even more fibrous than that of the right fore, and was closely beset with encapsuled caseo-calcareous nodules ranging in size from a millet seed to a large pea. Around the root of the teat there were some larger nodules up to 1.5 cm. in diameter, some of which were brownish translucent and beset with calcareous foci, others caseo-calcareous and encapsuled.

The two hind-quarters were of about equal size; the tissue was very fibroid, and showed on section a white fibrous network and brownish translucent tissue representing the glandular tissue; there was no definite lobulation. Scattered evenly throughout both of the quarters were caseous gritty nodules with fibrous walls varying up to 5 mm. in diameter.

The milk sinuses and ducts of the left hind quarter were completely obliterated, the former being represented by a small cavity lined with granulation tissue and filled with yellow pus, which did not communicate with the teat canal; the teat canal was filled with cheesy substance.

In the right hind quarter there were a good many patent milk ducts, and the milk sinuses were present, though apparently a good deal contracted; the walls of the sinuses and ducts were smooth, and the sinuses contained a small quantity of turbid fluid.

Supramammary Glands.—These glands showed no naked-eye evidence of tuberculosis.

Peripheral Lymphatic Glands.—All the peripheral glands were examined and found normal.

Microscopical Examination.

Emulsion of Left Prescapular Gland.—No tubercle bacilli.

Emulsion of Long Mediastinal Gland.—A moderate number of tubercle bacilli.

Emulsion of a Nodule from a Suprarenal Body.—Numerous tubercle bacilli.

Emulsion of a Nodule from the Pancreas.—A moderate number of tubercle bacilli, short and uniformly stained.

Smear of Muco-pus from a Nodule in the Lung.—Numerous tubercle bacilli.

Emulsion of a Supramammary Gland.—A moderate number of tubercle bacilli.

Animals Inoculated.

Guinea-pigs.—Two guinea-pigs, Nos. 3716 and 3717, were inoculated intraperitoneally with an emulsion made from the left prescapular gland; they were killed after 77 days, and showed slight general tuberculosis.

Two, Nos. 3718 and 3719, were inoculated intra-peritoneally with an emulsion of a nodule from the long mediastinal gland; they died of general tuberculosis in 26 and 28 days.

Two, Nos. 3714 and 3715, were inoculated intra-peritoneally with an emulsion of a supramammary gland. They died of general tuberculosis in 34 and 21 days.

FIG 99.

(Age—5 months 10 days.)

Feeding with milk of Cow 61, after her subcutaneous inoculation with the culture derived from Calf 1145, Virus H 81. "P.W."

Dose—The pig was fed daily for 21 days, receiving in all 6535 cc. of milk. The feeding commenced on August 10, 1907 (4 days after the inoculation of the cow) and ended on August 30, 1907.

Killed when in good health—October 28, 1907. [79 days after the commencement of the experiment.]

Clinical Notes.

The pig showed no sign of ill-health during the experiment, and grew normally.

Total gain of weight.—2 qrs. 3 lbs.

Average rate of gain per week—5.0 lbs.

Tuberculin Test.

October 24, 1907 (78 days). No reaction. No rise of temperature.

Weights.

			cwt.	qrs.	lbs.
August 10, 1907	...	...	1	2	21
October 28, 1907	...	...	2	0	24

POST-MORTEM EXAMINATION.

The carcass was fat.

There was no sign of tuberculosis.

All the organs and lymphatic glands were examined and found to be perfectly healthy.

GUINEA-PIGS INOCULATED WITH MILK OF COW 61.

Date.	No. of Guinea-pig.	Mode of Injection.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Aug. 2, 1907 [before inoculation].	2512	Intrap.	L.F.	5.0 cc.	K.	45 days	Normal.
	2513	"	"	5.0 cc.	"	"	Normal.
	2514	"	L.H.	5.0 cc.	"	"	Normal.
	2515	"	"	5.0 cc.	"	"	Normal.
	2516	"	R.F.	4.0 cc.	"	"	Normal.
	2517	"	"	4.0 cc.	"	"	Normal.
	2518	"	R.H.	5.0 cc.	"	"	Normal.
	2519	"	"	5.0 cc.	"	"	Normal.
Aug. 7, 1907 [24 hours after subcutaneous inoculation with virus H 81. P.W.].	2524	Intrap.	L.F.	10.0 cc.	K.	54 days	Normal.
	2525	"	"	10.0 cc.	"	"	Normal.
	2526	"	L.H.	10.0 cc.	"	"	Normal.
	2527	"	"	10.0 cc.	"	"	Normal.
	2528	"	R.H.	10.0 cc.	"	"	Normal.
	2529	"	"	10.0 cc.	"	"	Normal.
	2530	"	R.F.	0.5 cc.	"	"	Normal.
	2531	Intrap.	L.F. }	Each received the centrifuged deposit of 30.0 cc. plus 10.0 cc. of uncentrifuged milk.	K.	41 days	Normal.
	2532	"	" }		"	"	Normal.
	2533	"	L.H. }	Do. do.	"	"	Normal.
	2534	"	" }		"	"	Normal.
	2535	"	R.H. }	Do. do.	"	"	Normal.
	2536	"	" }		"	"	Normal.
Aug. 9, 1907 [3 days after inoculation].	2537	Intrap.	L.F.	10.0 cc.	K.	53 days	Normal.
	2538	"	"	10.0 cc.	"	"	Normal.
	2539	"	L.H.	10.0 cc.	"	"	Normal.
	2540	"	"	10.0 cc.	"	"	Normal.
	2541	"	R.H.	10.0 cc.	"	"	Normal.
	2542	"	"	10.0 cc.	"	"	Normal.
	2543	"	R.F.	About 0.5 cc.	"	"	Normal.
	2544	Intrap.	L.F. }	Each received the centrifuged deposit of 30.0 cc. plus 10.0 cc. of uncentrifuged milk.	K.	46 days	Normal.
	2545	"	" }		"	"	Normal.
	2546	"	L.H. }	Do. do.	"	"	Normal.
	2547	"	" }		"	"	Normal.
	2548	"	R.H. }	Do. do.	"	"	Normal.
	2549	"	" }		"	"	Normal.
Aug. 13, 1907 [7 days after inoculation].	2550	Intrap.	L.F., L.H., and R.H. }	Each received 10.0 cc. of mixed milk from these quarters.	K.	58 days	Normal.
	2551	"			"	"	Normal.
	2552	"			"	"	Normal.
	2553	"			"	"	Normal.
	2554	"	R.F.	10.0 cc. drawn by hand and filtered.	"	"	Chronic general tuberculosis

GUINEA-PIGS INOCULATED WITH MILK OF COW 61—*continued.*

Date.	No. of Guinea-pig.	Mode of Injection.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Aug. 13, 1907 [7 days after inoculation]— <i>continued.</i>	2555	Intrap.	L.F., L.H., and R.H.	Mixed milk. Each guinea-pig received the centrifuged deposit of 30.0 cc. plus 10.0 cc. of uncentrifuged milk.	K.	49 days	Normal.
	2556	"			"	"	Normal.
	2557	"			"	58 days	Normal.
	2558	"			"	"	Normal.
Aug. 20, 1907 [14 days after inoculation].	2570	Intrap.	L.F.	10.0 cc.	K.	62 days	Normal.
	2571	"	"	10.0 cc.	"	"	Normal.
	2572	"	L.H.	10.0 cc.	"	"	Normal.
	2573	"	"	10.0 cc.	"	"	Normal.
	2568	"	R.H.	10.0 cc.	"	"	Normal.
	2569	"	"	10.0 cc.	"	"	Normal.
	2566	"	R.F.	1.5 cc.	"	"	Normal.
	2567	"	"	1.5 cc.	"	"	Normal.
Sept. 10, 1907 [35 days after inoculation].	2585	Intrap.	L.F.	10.0 cc.	K.	51 days	Normal.
	2586	"	"	10.0 cc.	"	"	Normal.
	2587	"	L.H.	10.0 cc.	"	"	Normal.
	2588	"	"	10.0 cc.	"	"	Normal.
	2583	"	R.H.	10.0 cc.	"	"	Normal.
	2584	"	"	10.0 cc.	"	"	Normal.
Sept. 17, 1907 [42 days after inoculation].	2598	Intrap.	L.F.	10.0 cc.	K.	59 days	Normal.
	2599	"	"	20.0 cc.	"	"	Normal.
	2600	"	L.H.	Each received the centrifuged deposit of 30.0 cc. plus 10.0 cc. of uncentrifuged milk.	"	"	Normal.
	2601	"	"		"	"	Normal.
	2602	"	R.H.	Do. do.	"	"	Normal.
	2603	"	"		"	"	Normal.
	2604	"	R.F.	1.0 cc.	"	"	Normal.
Oct. 8, 1907 [63 days after inoculation].	2617	Intrap.	L.F.	10.0 cc.	K.	48 days	Normal.
	2618	"	"	10.0 cc.	"	"	Normal.
	2613	"	L.H.	10.0 cc.	"	"	Normal.
	2614	"	"	20.0 cc.	"	"	Normal.
	2615	"	"	20.0 cc.	"	"	Normal.
	2616	"	"	30.0 cc.	D.	9 days	Peritonitis.
	2619	"	R.H.	20.0 cc.	K.	48 days	Normal.
	2620	"	"	30.0 cc.	"	"	Normal.
Oct. 12, 1907 [67 days after inoculation].	2622	Intrap.	L.H.	10.0 cc. of milk withdrawn with catheter.	K.	54 days	Normal.
	2623	"	"		"	"	Normal.
	2624	Intrap.	L.H.	10.0 cc. of milk withdrawn by hand.	"	"	Normal.
	2625	"	"		"	"	Normal.

GUINEA-PIGS INOCULATED WITH MILK OF COW 61—*continued*.

Date.	No. of Guinea-pig.	Mode of Injection.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.	
Oct. 29, 1907 [84 days after inoculation].	2650	Intrap.	L.F.	10.0 cc.	K.	65 days	Normal.	
	2651	"	"	8.0 cc.	"	"	Normal.	
	2652	"	L.H.	10.0 cc.	"	"	Normal.	
	2653	"	"	10.0 cc.	"	"	Normal.	
	2654	"	R.H.	10.0 cc.	"	"	Normal.	
	2655	"	"	10.0 cc.	"	"	Normal.	
	2656	"	R.F.	Small quantity with- drawn with catheter.	"	"	Normal.	
	2657	"	"	About 5.0 cc. with- drawn by hand.	"	"	Normal.	
Date of Inoculation.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Inoculation.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Nov. 5, 1907 [24 hours after second (intravenous) inoculation with Virus H 83. "G.C."].	L.F. 10.0 cc.	2677	Intrap.	L.F.	5.0 cc.	K.	59 days	Slight general tuberculosis.
		2678	"	"	5.0 cc.	"	"	Slight general tuberculosis.
	L.H. 65.0 cc.	2671	"	L.H.	10.0 cc.	"	"	Slight general tuberculosis.
		2672	"	"	20.0 cc.	"	"	Slight general tuberculosis.
	R.H. 40.0 cc.	2675	"	R.H.	10.0 cc.	"	"	General tuberculosis.
		2676	"	"	10.0 cc.	"	"	Slight general tuberculosis.
	R.F. 6.0 cc.	2673	"	R.F.	About 3.0 cc. of filtrate (uncentrifuged) each.	"	"	Slight general tuberculosis.
	2674	"	"	"		"	"	Slight general tuberculosis.
Nov. 6, 1907 [48 hours after reinoculation].	L.F. 6.0 cc.	2681	Intrap.	L.F.	About 6.0 cc.	K.	61 days	Slight general tuberculosis.
	L.H. 62.0 cc.	2684	"	L.H.	10.0 cc.	"	"	Early general tuberculosis.
		2685	"	"	10.0 cc.	"	"	General tuberculosis.
	R.H. 35.0 cc.	2682	"	R.H.	10.0 cc.	"	"	Early general tuberculosis.
		2683	"	"	20.0 cc.	"	"	Early general tuberculosis.
	R.F. 2.0 cc.	2686	"	R.F.	About 2.0 cc. of filtrate (uncentrifuged).	"	"	General tuberculosis.
Nov. 7, 1907 [3 days after reinoculation].	L.F. 10.0 cc.	2693	Intrap.	L.F.	10.0 cc.	K.	64 days	Early general tuberculosis.
	L.H. 50.0 cc.	2689	"	L.H.	10.0 cc.	"	"	Slight general tuberculosis.
		2690	"	"	10.0 cc.	"	"	General tuberculosis.
	R.H. 40.0 cc.	2691	"	R.H.	10.0 cc.	"	"	No tuberculosis.
		2692	"	"	10.0 cc.	"	"	Early general tuberculosis.
	R.F. 1.0 cc.	2694	"	R.F.	1.0 cc. of filtrate.	"	"	No tuberculosis.
Nov. 9, 1907 [5 days after reinoculation].	110.0 cc.	2708	Intrap.	L.F. L.H. & R.H.	Each received 20.0 cc. of mixed milk from these quarters.	K.	62 days	Early general tuberculosis.
		2709	"			D.	6 days	No tuberculosis. Cause of death not determined.
Nov. 11, 1907 [7 days after reinoculation].	65.0 cc.	2711	Intrap.	L.F. L.H. & R.H.	Each received 20.0 cc. of mixed milk.	K.	60 days	Early general tuberculosis.
		2712	"			"	"	Slight general tuberculosis.

GUINEA-PIGS INOCULATED WITH MILK OF COW 61—*continued*.

Date of Inoculation.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Inoculation.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Nov. 12, 1907 [8 days after reinoculation].	24.0 cc.	2713	Intrap.	} L.F. L.H. & R.H.	10.0 cc. of mixed milk, filtered.	K.	59 days	Early general tuberculosis.
		2714	"		14.0 cc. of mixed milk, filtered.	"	"	Early general tuberculosis.
Nov. 14, 1907 [10 days after reinoculation].	L.F. 1.0 cc.	2727	Intrap.	L.F.	About 1.0 cc.	K.	63 days	No tuberculosis.
	L.H. 20.0 cc.	2725	"	L.H.	10.0 cc.	"	"	Early general tuberculosis.
	R.H. 10.0 cc.	2726	"	"	10.0 cc.	"	"	General tuberculosis of moderate severity.
		2724	"	R.H.	10.0 cc.	"	"	No tuberculosis.
Nov. 16, 1907 [12 days after reinoculation].	L.H. 18.0 cc.	2741	Intrap.	L.H.	18.0 cc.	D.	8 days	An acute infection.
	R.H. 18.0 cc.	2740	"	R.H.	18.0 cc.	K.	69 days	Slight general tuberculosis.
Nov. 19, 1907 [15 days after reinoculation].	L.H. 20.0 cc.	2751	Intrap.	L.H.	10.0 cc.	K.	69 days	No tuberculosis.
	R.H. 18.0 cc.	2750	"	R.H.	18.0 cc.	"	"	General tuberculosis.
Dec. 18, 1907 [44 days after reinoculation].	L.H. 22.0 cc.	2855	Intrap.	L.H.	About 15.0 cc.	K.	97 days	No tuberculosis.
		2856	"	"	About 7.0 cc.	D.	86 days	Severe general tuberculosis.
	R.H. 30.0 cc.	2857	"	R.H.	20.0 cc.	K.	97 days	Spontaneous tuberculosis.
		2858	"	"	10.0 cc.	D.	8 days	No tuberculosis.
Jan. 28, 1908 [85 days after reinoculation].	Less than 0.5 cc.	2919	Intrap.	R.H.	Less than 0.5 cc.	K.	62 days	No tuberculosis.

Guinea-pigs inoculated with the fluid obtained after flushing the two forequarters with normal saline solution on April 15, 1908 (see clinical history).

Date.	No. of Guinea-pig.	Mode of Injection.	Quarter of Udder.	Dose.	Killed or Died.	Duration of Life.	Result.
April 15, 1908 [163 days after reinoculation].	3027	Intrap.	L.F.	1.0 cc. of fluid	D.	34 days	Early general tuberculosis.
	3028	Intrap.	R.F.	1.0 cc. of fluid	D.	36 days	General tuberculosis moderately severe.

Guinea-pigs inoculated with the fluid obtained after flushing three of the quarters with normal saline solution on April 15, 1909 (see clinical history).

April 15, 1909 [528 days after reinoculation].	3712	Intrap.	L.F.	4.0 cc. of fluid.	D.	25 days	General tuberculosis.
	3711	Intrap.	R.F.	4.0 cc. of fluid.	D.	34 days	General tuberculosis.
	3713	Intrap.	R.H.	4.0 cc. of fluid.	D.	21 days	General tuberculosis.

RABBITS INOCULATED WITH MATERIAL OBTAINED FROM THE UDDER OF COW 61.

(a) *Inoculation of rabbits with the fluid obtained after flushing the two forequarters with normal saline solution on April 15, 1908 (see clinical history).*

Date.	No. of Rabbit.	Mode of Injection.	Quarter of Udder.	Dose.	Killed or Died.	Duration of Life.	Result.
April 15, 1908 [163 days after reinoculation].	1825	Intrav.	L.F.	1.0 cc. of fluid.	K.	174 days	Very slight T. of lungs and kidneys.
	1826	Intrav.	R.F.	3.0 cc. of fluid.	D.	29 days.	Fairly numerous discrete grey sub-miliary tubercles in the lungs; scattered minute foci in the liver.

(b) *Inoculation of rabbits with pus [from L.F., L.H., and R.F. quarters] and milk [from R.H. quarter] on October 15, 1908.*

Oct. 15, 1908 [346 days after reinoculation].	2045	Intrav.	L.F.	Rather larger dose than 2044.	K.	161 days	Tuberculosis of lungs and kidneys (slight).
	2046	Intrav.	L.H.	Do. do.	K.	161 "	Tuberculosis of lungs and kidneys.
	2044	Intrav.	R.F.	Small quantity of pus suspended in saline.	K.	161 "	Tuberculosis of lungs and one kidney.
	2043	Intrav.	R.H.	About 3.0 cc. of milk.	K.	161 "	Slight tuberculosis of lungs.

(c) *Rabbits inoculated with the fluid obtained after flushing three of the quarters with normal saline solution on April 15, 1909 (see clinical history).*

April 15, 1909 [528 days after reinoculation].	2305	Intrav.	L.F.	4.0 cc. of fluid	D.	102 days	Slight general tuberculosis apparently insufficient to account for death.
	2306	Intrav.	"	Do. do.	K.	138 "	Slight T. of lungs and kidneys.
	2303	Intrav.	R.F.	Do. do.	K.	138 "	Slight T. of lungs, kidneys and mammary gland.
	2304	Intrav.	"	Do. do.	K.	138 "	Slight T. of lungs and kidneys.
	2307	Intrav.	R.H.	Do. do.	K.	138 "	Slight T. of lungs only.
	2308	Intrav.	"	Do. do.	D.	102 "	Slight T. of lungs and kidneys. ? cause of death.

GUINEA-PIGS INOCULATED WITH THE FAECES OF COW 61.

Date.	No. of Guinea-pig.	Mode of Injection.	Dose of Faeces.	Killed or Died.	Duration of Life.	Result.
Oct. 12, 1907 [67 days after subcutaneous inoculation].	2627	Intrap.	1.0 cc. }	K.	54 days	No tuberculosis.
	2628	"	1.0 cc. }			No tuberculosis.
	2629	"	0.5 cc. }			No tuberculosis.
Nov. 4, 1907 [90 days after inoculation].	2666	Intrap.	1.0 cc. }	D.	11 days	? Tuberculosis of omentum.
	2667	"	1.0 cc. }			Pseudo-tuberculosis of spleen.
	2668	"	2.0 cc. }			No tuberculosis.

GUINEA-PIGS INOCULATED WITH THE FAECES OF COW 61—*continued.*

Date.	No. of Guinea-pig.	Mode of Injection.	Dose of Faeces.	Killed or Died.	Duration of Life.	Result.
Nov. 5, 1907 [24 hours after intravenous inoculation].	2679	Intrap.	0.5 cc. { Emulsion of faeces—1 in 10 dilution. }	K.	59 days	No tuberculosis.
	2680	"	0.5 cc. }	D.	6 days	No tuberculosis.
Nov. 6, 1907 [48 hours after reinoculation].	2687*	Intrap.	1.0 cc. { Emulsion of faeces—1 in 20 dilution. }	D.	8 days	The cause of death was not apparent.
	2688	"	1.0 cc. }	K.	61 days	No tuberculosis.
Nov. 7, 1907 [3 days after reinoculation].	2695	Intrap.	1.0 cc. { Do. do. }	D.	7 days	The cause of death was not apparent.
	2696	"	1.0 cc. }	K.	64 days	No tuberculosis.
Nov. 14, 1907 [10 days after reinoculation].	2728	Intrap.	1.0 cc. { Do. do. }	D.	5 days	Subacute infection.
	2729	"	1.0 cc. }	K.	63 days	Early general tuberculosis.
Nov. 16, 1907 [12 days after reinoculation].	2742	Intrap.	1.0 cc. { Do. do. }	D.	7 days	No macroscopic evidence of tuberculosis.
	2743	"	1.0 cc. }	K.	6 days	Subacute infection.

GUINEA-PIG INOCULATED WITH THE EPITHELIAL SCALES FROM THE UDDER OF COW 61.

Date.	No. of Guinea-pig.	Mode of Injection.	Material inoculated.	Killed or Died.	Duration of Life.	Result.
Oct. 12, 1907 [67 days after subcutaneous inoculation].	2626	Intrap.	Emulsion of epithelial scales scraped from the udder.	K.	54 days	Normal.

RABBITS INOCULATED WITH CULTURES DERIVED FROM THE MILK OF COW 61.

Date of Inoculation.	Immediate Source of Culture.	Dose in Milli-grammes.	No. of Rabbit.	Mode of Inoculation.	Weights.		Duration of Life.	Result.
					Initial.	Final.		
Aug. 5, 1908	On April 15, 1908, a little of the milky fluid withdrawn from the R.F. quarter after flushing with saline was spread on a tube and a culture raised from it.	1.0 mg.	1957	Intrav.	2,000	2,570	K. 83 days	Slight T. of lungs and kidneys.
		0.1 mg.	1958	Intrav.	1,500	2,300	K. 83 "	Slight T. of lungs and kidneys.
		0.1 mg.	1959	Intrav.	2,300	2,620	K. 83 "	Very slight T. of lungs and one kidney.
Oct. 5, 1908	On Aug. 6, 1908, some of the pus expressed from the L.F. quarter was sown on a culture tube, and a culture was raised from it.	1.0 mg.	2027	Intrav.	2,300	1,450	D. 33 days	Generalised T. not severe.
		0.1 mg.	2028	Intrav.	2,270	2,200	K. 164 "	Slight T. of lungs and kidneys.
		0.01 mg.	2029	Intrav.	2,070	2,970	K. 164 "	Slight T. of lungs and kidneys.
July 23, 1909	On April 15, 1909, the day before the cow was killed, a little of the fluid withdrawn from the L.F. quarter after flushing with saline was spread on a tube and a culture raised from it.	0.1 mg.	2397	Intrav.	1,500	2,000	K. 75 days	Slight T. of lungs and kidneys.
		0.1 mg.	2398	Intrav.	1,850	2,350	K. 75 "	Slight T. of lungs, kidneys and tracheal gland.
		0.01 mg.	2395	Intrav.	1,800	1,100	D. 28 "	Slight general tuberculosis.
		0.01 mg.	2396	Intrav.	1,650	2,320	K. 75 "	Slight T. of lungs and kidneys.

EXPERIMENT D.

COW 565.

(Age—4½ years.)

Intravenous inoculation of culture derived from a human lung direct (Virus H 104. "E.R.).

Dose—10·0 milligrammes.

Date of Inoculation—February 18, 1909.

Killed when in good health—August 19, 1909. [182 days after inoculation.]

Clinical Notes.

On February 21, 1909, 10·0 cc. of milk taken from each of 3 quarters (left fore, right fore, and right hind) were centrifuged; there was no deposit. The milk from each quarter was examined microscopically, and no tubercle bacilli were seen. The left hind quarter of the udder was dry when the cow was inoculated.

The following day milk from the R.F. and R.H. quarters was centrifuged; the deposit which was very small in amount was examined microscopically; it consisted in each case of cells mainly leucocytes, a few lymphocytes and alveolar cells; no tubercle bacilli were seen. No colonies of the tubercle bacillus appeared on culture tubes sown from the deposit.

Centrifuged deposits from the milk of the L.F., R.F., and R.H. quarters obtained on the 77th and 133rd days after the inoculation of the cow were examined microscopically, and culture tubes were sown; no tubercle bacilli were seen in any of the smears, and of the culture tubes some remained sterile and others became contaminated.

On July 21, 1909, 153 days after her inoculation, the cow gave birth to a dead foetus (8 months).

The foetus showed no sign of tuberculosis. Emulsions were made from its spleen and a portal gland (no tubercle bacilli were seen in smears made from either emulsion) and inoculated intraperitoneally each into two guinea-pigs. The guinea-pigs were killed after 41 days and found healthy.

A large amount of thin purulent fluid came away from the uterus at the time of the birth of the foetus. Microscopically this contained very numerous tubercle bacilli.

During the next two or three days there was slight discharge from the vagina, and on July 27 some membranes and purulent fluid were passed. Numerous tubercle bacilli were again demonstrated in the fluid.

On August 5, 1909, centrifuged deposits from the milk of the L.F., R.F., and R.H. quarters were examined microscopically. The smear preparation from the R.F. quarter showed one doubtful tubercle bacillus; no tubercle bacilli were seen in the others.

On August 16, centrifuged deposits from the milk of the three quarters were examined; no tubercle bacilli were seen in any of the smear preparations. Culture tubes sown with the deposit grew other organisms but no tubercle bacilli.

The cow remained well during the experiment, and was in moderately good condition when killed.

Temperature.

There was a very slight rise of temperature com-

mencing on the 11th day after inoculation and lasting twelve days (maximum 40·0° C.). With this exception the temperature was normal during the experiment.

Tuberculin Test.

August 16, 1909. [179 days after inoculation.]
Dose 3·0 cc. Reacted. Rise of temperature, 1·7° C.

Weights.

		cwt.	qrs.	lbs.
February 18, 1909	...	8	2	16
August 19, 1909	...	7	0	16

POST-MORTEM EXAMINATION.

The carcass was fat.

The Lungs and Thoracic Glands, the Liver, Spleen and Suprarenal Bodies were normal.

Kidneys.—In the medulla of one of the kidneys there were two grey foci of a doubtful nature (a smear showed no tubercle bacilli). The other kidney was normal.

Iliac Glands.—One showed a soft greenish-yellow focus (in a smear preparation made from it no tubercle bacilli were seen).

Mamma.—One quarter (the left hind) was atrophied and fibroid; the others were normal.

Uterus.—The right cornua of the uterus was enlarged, being about twice the size of the left; the mucous membrane was slightly swollen and showed signs of old congestion; it had a brownish-red colour, that of the other cornua being pinkish; the walls were a little thickened but were not otherwise abnormal. There was no naked-eye evidence of tuberculosis anywhere.

All the remaining organs and glands were examined and found normal.

Microscopical Examinations.

Scrapings from the Mucous Membrane of the Right Horn of the Uterus.—Three smear preparations from each of three separate scrapings were examined; one, two, and three tubercle bacilli respectively were found in them after long search.

Guinea-pigs Inoculated.

Two guinea-pigs, Nos. 3870 and 3871 were inoculated intraperitoneally each with a separate emulsion of scrapings from the mucous membrane of the right horn of the uterus. They were killed after 50 days and showed general tuberculosis.

GUINEA-PIGS INOCULATED WITH THE MILK OF COW 565.

Date.	Total yield of milk in 24 hours.	No. of Guinea-pig.	Mode of Inoculation.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life	Result.
Feb. 18, 1909 [Before inoculation].	—	3511	Intrap.	L.F.	9.0 cc.	K.	107 days	Healthy.
		3509	"	R.F.	10.0 cc.	K.	107 "	"
		3510	"	R.H.	10.0 cc.	K.	107 "	"
Feb. 19, 1909 [24 hours after inoculation].	L.F. { 1070.0 cc.	3518	Intrap.	L.F.	10.0 cc. + the centri-fuged deposit of 30.0 cc. each.	K.	43 days	No tuberculosis.
		3519	"	"	"	K.	43 "	" "
	R.F. { 1064.0 cc.	3520	"	R.F.	"	K.	43 "	" "
		3521	Intrap. and partly Sub-perit. Intrap.	"	"	K.	43 "	" "
	R.H. { 1366.0 cc.	3516	"	R.H.	"	K.	43 "	" "
		3517	"	"	"	K.	43 "	Early slight general tuberculosis.
Feb. 20, 1909 [48 hours after inoculation].	L.F. { 1471.0 cc.	3546	Intrap.	L.F.	10.0 cc.	K.	45 days	No tuberculosis.
		3547	"	"	"	K.	45 "	" "
	R.F. { 1015.0 cc.	3544	"	R.F.	"	K.	45 "	" "
		3545	"	"	"	K.	45 "	" "
	R.H. { 1713.0 cc.	3542	"	R.H.	"	K.	45 "	" "
		3543	"	"	"	K.	45 "	" "
Feb. 21, 1909 [3 days after inoculation].	L.F. { 1362.0 cc.	3552	Intrap.	L.F.	10.0 cc.	K.	50 days	No tuberculosis.
		3553	"	"	"	K.	50 "	" "
	R.F. { 1012.0 cc.	3550	"	R.F.	"	K.	50 "	" "
		3551	"	"	"	K.	50 "	" "
	R.H. { 1801.0 cc.	3548	"	R.H.	"	K.	50 "	" "
		3549	"	"	"	K.	50 "	" "
Feb. 22, 1909 [4 days after inoculation].	L.F. { 1690.0 cc.	3558	Intrap.	L.F.	10.0 cc.	K.	50 days	No tuberculosis.
		3559	"	"	"	K.	50 "	" "
	R.F. { 1098.0 cc.	3556	"	R.F.	"	K.	50 "	" "
		3557	"	"	"	K.	50 "	" "
	R.H. { 1990.0 cc.	3554	"	R.H.	"	K.	50 "	" "
		3555	"	"	"	K.	50 "	" "
Feb. 23, 1909 [5 days after inoculation].	L.F. { 1373.0 cc.	3562	Intrap.	L.F.	10.0 cc.	K.	55 days	No tuberculosis.
		3563	"	"	"	K.	55 "	" "
	R.F. { 980.0 cc.	3564	"	R.F.	"	K.	55 "	" "
		3565	"	"	"	K.	55 "	Slight general tuberculosis.
	R.H. { 1620.0 cc.	3560	"	R.H.	"	K.	55 "	General tuberculosis.
		3561	"	"	"	K.	55 "	No tuberculosis.
Feb. 24, 1909 [6 days after inoculation].	L.F. { 1285.0 cc.	3572	Intrap.	L.F.	10.0 cc.	K.	55 days	No tuberculosis.
		3573	"	"	"	K.	55 "	" "
	R.F. { 900.0 cc.	3574	"	R.F.	"	K.	55 "	Slight general tuberculosis.
		3575	"	"	"	K.	55 "	No tuberculosis.
	R.H. { 1575.0 cc.	3570	"	R.H.	"	K.	55 "	" "
		3571	"	"	"	K.	55 "	" "

GUINEA-PIGS INOCULATED WITH THE MILK OF COW 565—*continued*.

Date.	Total yield of milk in 24 hours.	No. of Guinea-pig.	Mode of Inoculation.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Feb. 25, 1909 [7 days after inoculation].	L.F. { 1570.0 cc.	3580	Intrap.	L.F.	10.0 cc.	K.	57 days	General tuberculosis.
		3581	"	"	"	K.	57 "	" "
	R.F. { 1105.0 cc.	3578	"	R.F.	"	K.	57 "	" "
		3579	"	"	"	K.	57 "	" "
	R.H. { 1860.0 cc.	3576	"	R.H.	"	K.	57 "	No tuberculosis.
		3577	"	"	"	K.	57 "	" "
March 4, 1909 [14 days after inoculation].	L.F. { 1600.0 cc.	3589	Intrap.	L.F.	10.0 cc.	K.	50 days	Slight tuberculosis.
		3590	"	"	"	K.	50 "	No tuberculosis.
	R.F. { 1150.0 cc.	3591	"	R.F.	"	K.	50 "	General tuberculosis.
		3592	"	"	"	K.	50 "	No tuberculosis.
	R.H. { 2030.0 cc.	3587	"	R.H.	"	K.	50 "	General tuberculosis, not severe.
		3588	"	"	"	D.	27 "	No tuberculosis.
March 18, 1909 [28 days after inoculation].	All three quarters 4815.0 cc.	3627	Intrap.	L.F.	10.0 cc.	D.	11 days	No tuberculosis.
		3628	"	"	"	K.	42 "	" "
		3625	"	R.F.	"	K.	42 "	" "
		3626	"	"	"	K.	42 "	" "
		3629	"	R.H.	"	K.	42 "	" "
		3630	"	"	"	K.	42 "	" "
April 1, 1909 [42 days after inoculation].	All three quarters 4300.0 cc.	3657	Intrap.	L.F.	10.0 cc.	D.	32 days	No tuberculosis.
		3658	"	"	"	K.	56 "	" "
		3659	"	R.F.	"	K.	56 "	" "
		3660	"	"	"	K.	56 "	" "
		3655	"	R.H.	"	K.	56 "	" "
		3656	"	"	"	K.	56 "	" "
April 22, 1909 [63 days after inoculation].	—	3728	Intrap.	L.F.	10.0 cc.	K.	51 days	No tuberculosis.
		3729	"	"	"	K.	51 "	" "
		3724	"	R.F.	"	K.	51 "	" "
		3725	"	"	"	K.	51 "	" "
		3726	"	R.H.	"	K.	51 "	" "
		3727	"	"	"	K.	51 "	" "
May 6, 1909 [77 days after inoculation].	L.F. { 820.0 cc.	3755	Intrap.	L.F.	10.0 cc.	K.	71 days	No tuberculosis.
		3756	"	"	"	K.	71 "	" "
	R.F. { 530.0 cc.	3757	"	R.F.	"	D.	12 "	No tuberculosis. (Death from pseudo-tuberculosis.)
		3758	"	"	"	K.	71 "	No tuberculosis.
	R.H. { 1150.0 cc.	3753	"	R.H.	"	K.	71 "	" "
		3754	"	"	"	K.	71 "	" "
June 3, 1909 [105 days after inoculation].	L.F. { 550.0 cc.	3773	Intrap.	L.F.	10.0 cc.	K.	56 days	No tuberculosis.
		3774	"	"	"	K.	56 "	" "
	R.F. { 370.0 cc.	3775	"	R.F.	"	K.	56 "	" "
		3776	"	"	"	K.	56 "	" "
	R.H. { 990.0 cc.	3771	"	R.H.	"	K.	56 "	" "
		3772	"	"	"	K.	56 "	" "

GUINEA-PIGS INOCULATED WITH THE MILK OF COW 565—continued.

Date.	Total yield of milk in 24 hours.	No. of Guinea-pig.	Mode of Inoculation.	Quarter of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
July 1, 1909 [133 days after inoculation].	L.F. 367.0 cc.	3791	Intrap.	L.F.	10.0 cc.	K.	53 days	No tuberculosis.
		3792	"	"	"	K.	53 "	" "
	R.F. 231.0 cc.	3795	"	R.F.	"	K.	53 "	" "
		3796	"	"	"	K.	53 "	" "
	R.H. 740.0 cc.	3793	"	R.H.	"	K.	53 "	" "
		3794	"	"	"	K.	53 "	" "
August 5, 1909 [168 days after inoculation, and 15 days after giving birth to a dead foetus].	—	3822	Intrap.	L.F.	10.0 cc.	K.	60 days	No tuberculosis.
		3823	"	"	"	K.	60 "	" "
	—	3826	"	R.F.	"	K.	60 "	" "
		3827	"	"	"	K.	60 "	" "
	—	3824	"	R.H.	"	K.	60 "	" "
		3825	"	"	"	D.	4 "	" "
August 12, 1909 [175 days after inoculation].	L.F. 2050.0 cc.	3842	Intrap.	L.F.	10.0 cc.	K.	53 days	No tuberculosis.
		3843	"	"	"	K.	53 "	" "
	R.F. 2340.0 cc.	3840	"	R.F.	"	K.	53 "	" "
		3841	"	"	"	K.	53 "	" "
	R.H. 2440.0 cc.	3844	"	R.H.	"	K.	53 "	General tuberculosis apparently of spontaneous origin.
		3845	"	"	"	K.	53 "	No tuberculosis.
August 14, 1909 [177 days after inoculation].	L.F. 1670.0 cc.	3850	Intrap.	L.F.	10.0 cc.	K.	52 days	No tuberculosis.
		3851	"	"	"	K.	52 "	" "
	R.F. 1900.0 cc.	3848	"	R.F.	"	K.	52 "	" "
		3849	"	"	"	K.	52 "	" "
	R.H. 1520.0 cc.	3846	"	R.H.	"	K.	52 "	" "
		3847	"	"	"	K.	52 "	" "
August 16, 1909 [179 days after inoculation].	L.F. 2200.0 cc.	3852	Intrap.	L.F.	10.0 cc.	K.	52 days	No tuberculosis.
		3853	"	"	"	K.	52 "	" "
	R.F. 2220.0 cc.	3856	"	R.F.	"	K.	52 "	" "
		3857	"	"	"	K.	52 "	" "
	R.H. 2170.0 cc.	3854	"	R.H.	"	K.	52 "	" "
		3855	"	"	"	K.	52 "	" "
August 19, 1909 [182 days after inoculation].	L.F. 1500.0 cc.	3858	Intrap.	L.F.	10.0 cc.	K.	50 days	No tuberculosis.
		3859	"	"	"	K.	50 "	" "
	R.F. 1580.0 cc.	3862	"	R.F.	"	K.	50 "	" "
		3863	"	"	"	K.	50 "	" "
	R.H. 1650.0 cc.	3860	"	R.H.	"	K.	50 "	" "
		3861	"	"	"	K.	50 "	" "

· PIG 145 (Boar) and PIG 147 (Sow).

(Each 11 weeks old.)

Fed daily for seven days from February 20 to 26, 1909, with the milk of Cow 565.

Dose—All the milk drawn from the cow during the seven days commencing February 20, 1909, was given to the pigs.

Killed when in good health—June 3, 1909. [97 days after the commencement of the experiment.]

Weights.

	<i>Pig 145.</i>			<i>Pig 147.</i>		
	cwts.	qrs.	lbs.	qrs.	lbs.	
February 20, 1909 ...		1	12	1	7	
June 3, 1909 ...	1	0	18	3	26	
Total gain of weight—		3	6	2	19	

POST-MORTEM EXAMINATIONS.

The carcasses were fat.

Pig 145 was healthy throughout.

Pig 147 showed one pinhead-sized calcareous tubercle in the left submaxillary gland (smear, no tubercle bacilli); all the other glands and the organs were healthy.

EXPERIMENT E.

GOAT 79 [Adult Female].

Subcutaneous inoculation of culture derived from the original material of Virus H. 110. "J.B." (a) through Guinea-pig 3007.

Dose—50·0 milligrammes.

Date of Inoculation—November 12, 1908.

Killed when apparently in good health—November 21, 1908. [9 days after inoculation.]

Clinical Notes.

Centrifuged deposit of milk from the left quarter was examined microscopically 24 hours after inoculation; no tubercle bacilli were seen.

Centrifuged deposit of milk from the same quarter was examined 48 hours after inoculation with the same result.

On the sixth day after inoculation milk from the left quarter was examined microscopically (only 0·5 cc. was obtained); and on the following day (November 19) a drop of milk from the left quarter was examined; no tubercle bacilli were seen on either occasion.

The goat was now "dry," the left side of the udder having ceased to yield any milk; the right side had ceased to yield three days previously. She was therefore killed, on November 21, 1908, 9 days after inoculation.

Twenty cubic centimetres of saline were injected into each milk sinus of the goat before she was killed, and then as much as possible was withdrawn, 16·0 cc. in the case of the right and 18·0 cc. in that of the left; the fluid was in each case slightly milky. Smear preparations from the fluid showed no tubercle bacilli.

Temperature.

The day after inoculation the temperature was 40·0° C., and the pyrexia continued until the goat was killed on the 9th day; the highest temperature recorded was 40·6° C.

Weights.

			qrs.	lbs.
November 12, 1908 ...	...	...	3	26
November 21, 1908 ...	...	...	3	20
Loss of weight.—6 lbs.				

POST-MORTEM EXAMINATION.

The carcass was in fair condition.

Local Lesion.—In the subcutaneous tissues on the left side of the neck there was a patch about the area of the palm of one's hand and 1 cm. thick, of yellow necrotic breaking-down substance adherent to and infiltrating both skin and muscles.

Left Prescapular Gland.—The left prescapular gland was much enlarged and showed the greater part of its cortex in a state of early caseation.

Right Prescapular Gland.—Normal.

Thorax.

Lungs.—The lungs were crepitant and contained a moderate number of deeply congested tubercles up to 1 mm. in diameter which could be distinctly felt between the finger and the thumb; a few had opaque yellowish centres.

Thoracic Glands.—Normal.

Mamma.—The left side of the mammary gland was larger than the right; the gland tissue and the mucous membrane of the milk sinuses were normal to the naked eye; the milk sinuses and ducts were practically empty.

Other organs and glands were normal to the naked eye.

There were two small fetuses in the uterus.

Microscopical Examinations.

Smears from emulsions of—

Lung.—No tubercle bacilli seen.

Liver.—No tubercle bacilli seen.

Spleen.—No tubercle bacilli seen.

Supramammary Gland.—No tubercle bacilli seen.

GUINEA-PIGS INOCULATED WITH THE BLOOD, AND WITH EMULSIONS OF VARIOUS TISSUES, FROM GOAT 79.

Material Inoculated.	No. of Guinea-pig.	Mode of Inoculation.	Dose.	Killed or Died.	Duration of Life.	Result.
Blood ... {	3376	Intrap.	5.5 cc.	K.	68 days	No tuberculosis.
	3377	Intrap.	5.5 cc.	K.	68 "	No tuberculosis.
Emulsion of lung ...	3378	Intrap.	—	D.	27 days	Moderately severe general tuberculosis.
Emulsion of supra-mammary gland.	3379	Intrap.	—	K.	68 days	General tuberculosis.
Emulsion of liver ...	3380	Intrap.	—	K.	68 "	General tuberculosis.
Emulsion of spleen	3381	Intrap.	—	D.	56 days	Moderately severe general tuberculosis.

GUINEA-PIGS INOCULATED WITH MILK OF GOAT 79.

Date.	Total yield of milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Nov. 12, 1908 [Before inoculation].		3355	Intrap.	Left	10.0 cc.	K.	205 days	Healthy.
		3356	"	"	10.0 cc.	D.	81 "	No tuberculosis.
		3357	"	Right	10.0 cc. (and a small quantity from Left)	K.	205 "	Healthy.
Nov. 13, 1908 [24 hours after inoculation].	Left half 36.0 cc.	3360	Intrap.	Left	10.0 cc.	K.	55 days	No tuberculosis.
		3361	"	"	10.0 cc.	K.	55 "	" "
	Right half 16.0 cc.	3358	"	Right	10.0 cc.	K.	55 "	" "
		3359	"	"	6.0 cc.	K.	55 "	" "
Nov. 14, 1908 [48 hours after inoculation].	Left half 24.0 cc.	3364	Intrap.	Left	10.0 cc.	K.	54 days	No tuberculosis.
		3365	"	"	10.0 cc.	K.	54 "	" "
	Right half 9.0 cc.	3362	"	Right	4.5 cc.	K.	54 "	" "
		3363	"	"	4.5 cc.	K.	54 "	General tuberculosis.
Nov. 15, 1908 [3 days after inoculation].	Left half 10.0 cc.	3367	Intrap.	Left	10.0 cc.	D.	26 days	T. of omentum and portal gland. Death from other causes.
	Right half 3.0 cc.	3366	"	Right	3.0 cc.	K.	53 "	Slight general tuberculosis.
Nov. 16, 1908 [4 days after inoculation].	Left half 3.0 cc.	3369	Intrap.	Left	3.0 cc.	K.	57 days	No tuberculosis.
	Right half 3 drops.	3368	"	Right	About 3 drops	D.	24 "	One tubercle in omentum. Death from other causes.
Nov. 17, 1908	Left half 0.5 cc.	3370	Intrap.	Left	About 0.5 cc.	K.	71 days	No tuberculosis.
Nov. 18, 1908	Left half 0.5 cc.	3371	Intrap.	Left	0.5 cc.	K.	70 days	No tuberculosis.

Guinea-pigs inoculated with the fluid obtained after flushing the two sides of the udder with normal saline on November 21, 1908 (see clinical history).

Date.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose.	Killed or Died.	Duration of Life.	Result.
Nov. 21, 1908 [9 days after inoculation].	3374	Intrap.	Left	10·0 cc. of fluid.	K.	67 days	No tuberculosis.
	3375	"	"	8·0 cc.	K.	67 "	" "
	3372	"	Right	10·0 cc. of fluid.	K.	67 "	General tuberculosis.
	3373	"	"	6·0 cc.	K.	67 "	" "

EXPERIMENT F.

GOAT 55 [Adult Female].

Subcutaneous inoculation of culture derived from a human mesenteric gland (Virus H 90. "I.P.").

Dose—50·0 milligrammes.

Date of Inoculation—November 14, 1907.

Killed when in good health—February 25, 1908. [103 days after inoculation.]

Clinical Notes.

Three weeks after inoculation there was an elongated raised local tumour measuring 11 by about 6 cm., the margins being rather ill-defined, soft, and fluctuating. A small opening had appeared at the inferior margin of the tumour a few days previously, from which a small quantity of pus was discharged. The discharge continued intermittently and the tumour decreased considerably in size; finally the discharge ceased and the opening healed, leaving a linear scar.

The condition of the goat at the close of the period of high temperature (*see below*) was fairly good; it had not shown any symptoms of illness, and it quickly improved in condition and remained well subsequently.

Centrifuged deposits of milk from the left and right halves of the udder were examined microscopically twenty-four hours after inoculation. No tubercle bacilli were seen in that from the left half, some (?) tubercle bacilli were seen in that from the right.

On the third and fourth days after inoculation centrifuged deposits from both halves were again examined, and no tubercle bacilli were found. On the second and fourth days after inoculation the faeces were microscopically examined; no tubercle bacilli were seen, but a few short thick acid-fast bacilli were seen on each occasion. (For milk inoculations *see table*.)

Temperature.

On the second day after inoculation the temperature rose to 40·1° C. and reached a maximum of 40·5° C. on the 11th day; the temperature was raised for a total period of 29 days, after which it was quite normal.

Tuberculin Test.

February 21, 1908. [99 days after inoculation.] Reacted. Rise of temperature, 2·3° C.

Weights.

			qrs.	lbs.
November 14, 1907	...	...	3	3
February 25, 1908	...	...	3	2

Loss of weight.—1 lb.

POST-MORTEM EXAMINATION.

The goat was in good condition.

Local Lesion.—The skin on the left side of the neck showed a linear scar 7 cm. in length; on section of the skin, through the centre of the scar and at right-angles to it, the subcutaneous tissues were seen to be thickened for a good distance around the scar and beset with softened yellow caseous nodules slightly gritty from calcification, ranging in size from a millet seed to a large pea, the larger nodules being situated chiefly towards the periphery of the thickened patch.

Left Prescapular Gland.—The left prescapular gland measured 5 by 2·5 by 1·7 cm.; it contained two large nodules, one 2 cm. in diameter, the other rather less, composed of soft caseous substance gritty around the margins.

Right Prescapular Gland.—The right prescapular gland measured 4·3 by 2·5 by 1·3 cm.; on section it showed a softened caseous nodule 1 cm. in diameter and about half-a-dozen miliary caseous tubercles.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were pink and crepitant and collapsed normally; they showed under the pleura as well as in the depth fairly numerous evenly distributed grey fibrous tubercles, the largest 1 mm. in diameter; some were slightly opaque in the centre. In the caudal lobes near the surface were many firm slightly raised patches, not so pink as the surrounding lung and composed apparently of aggregations of grey foci (pieces floated in water). They were caused by filariae, the embryos of which could be demonstrated in large numbers in a smear preparation.

Bronchial and Mediastinal Glands.—Normal.

Heart.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—Normal.

Liver.—A few yellow and greenish-yellow foci of a doubtful nature were seen in the substance.

Portal Glands.—Normal.

Kidneys.—In the cortex of one there was a pale grey streak; in that of the other just under the capsule there was a grey nodule (2 mm. in diameter). This on section penetrated the whole thickness of the cortex and had a yellow caseous centre and grey margins.

Suprarenal Bodies.—Normal.

Renal, Lumbar and Iliac Glands.—Normal.

Genito-Urinary System.

Mammary Gland.—The halves were cut up into thin longitudinal strips. On passing those of the left between the finger and thumb, a number of hard bodies were felt; these on section were tubercles about the size of millet seeds with fibrous margins and yellow caseous gritty centres which were readily shelled out; one of the tubercles projected into one of the ducts: besides these tubercles there were two hard nodules, the largest 1 cm. in diameter, which were composed of denser tissue than the surrounding gland tissue and contained yellow caseous foci; no tubercles were seen in the right gland, but there was a small firm patch beset with caseous points. The milk sinuses and ducts did not contain any milk and the mucous membrane was normal.

Supramammary Lymphatic Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Tonsils.—Normal.

Submaxillary and Retro-pharyngeal Glands.—Normal.

Intestines.—Normal.

Mesenteric Glands.—Most of the mesenteric glands contained a number of soft yellow gritty tubercles arranged around the cortex, and in places aggregated together to form irregular caseo-calcareous patches.

Peripheral Lymphatic Glands.—Normal.

Microscopical Examination.

Tubercle from Kidney.—One tubercle bacillus seen.

Focus from Liver.—No tubercle bacilli.

Firm Patch from Lung.—No tubercle bacilli. Numerous embryos.

Tubercle from Lung.—No tubercle bacilli seen.

Emulsion of Prescapular Gland.—Tubercle bacilli in moderate numbers.

Tubercle from Mesenteric Gland.—One tubercle bacillus seen after prolonged search.

Mammary Gland.—
 { The yellow centre of a tubercle. No tubercle bacilli seen.
 Three foci from one of the nodules. One tubercle bacillus seen.

Animals Inoculated.

Rabbits 1741 and 1742 were inoculated subcutaneously with an emulsion made from the left prescapular gland. Both died of general tuberculosis, the former in 145, the latter in 157 days.

Guinea-pig 2980 was inoculated intraperitoneally with an emulsion made from the spleen. It was healthy when killed after 94 days.

GUINEA-PIGS INOCULATED WITH THE MILK OF GOAT 55.

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Nov. 13, 1907 [before inoculation].		2721	Intrap.	Right	10.0 cc.	K.	57 days	Healthy.
		2722	"	Left	10.0 cc.	"	"	"
		2723	"	Right and Left (mixed).	10.0 cc.	"	"	"
Nov. 15, 1907 [24 hours after inoculation].	130.0 cc. both halves.	2730	Intrap.	Left	10.0 cc.	K.	60 days	Early general tuberculosis.
		2731	"	"	20.0 cc.	K.	60 days	Early general tuberculosis.
		2732	"	Right	10.0 cc.	D.	5 days	Pseudo-tuberculosis.
		2733	"	"	20.0 cc.	K.	60 days	Very slight general tuberculosis.
Nov. 16, 1907 [2 days after inoculation].	28.0 cc. left half.	2736	Intrap.	Left	Centrifuged deposit of 10.0 cc. Centrifuged deposit of 18.0 cc.	K.	53 days	General tuberculosis.
		2737	"	"		K.	53 days	Early general tuberculosis.
	65.0 cc. right half.	2738	"	Right	Centrifuged deposit of 18.0 cc. plus 10.0 cc. of uncentrifuged milk.	D.	1 day	Death from injury.
		2739	"	"	Centrifuged deposit of 27.0 cc. plus 10.0 cc. of uncentrifuged milk.	K.	53 days	No tuberculosis.
Nov. 17, 1907 [3 days after inoculation].	95.0 cc. both halves.	2744	Intrap.	Left	Centrifuged deposit of 30.0 cc.	K.	53 days	Early general tuberculosis.
		2745	"	Right	Centrifuged deposit of 65.0 cc.	K.	53 days	Slight general tuberculosis.

GUINEA-PIGS INOCULATED WITH THE MILK OF GOAT 55—*continued*.

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Nov. 18, 1907 [4 days after inoculation].	38.0 cc. left half.	2748	Intrap.	Left	Centrifuged deposit of 38.0 cc.	K.	52 days	Early slight general tuberculosis.
	68.0 cc. right half.	2749	"	Right	Centrifuged deposit of 68.0 cc.	K.	52 days	No tuberculosis.
Nov. 19, 1907 [5 days after inoculation].	34.0 cc. left half.	2752	Intrap.	Left	Centrifuged deposit of 30.0 cc. plus 4.0 cc. of uncentrifuged milk.	K.	69 days	General tuberculosis of moderate severity.
	74.0 cc. right half.	2753	"	Right	Centrifuged deposit of 70.0 cc. plus 4.0 cc. of uncentrifuged milk.	K.	69 days	Slight general tuberculosis.
Nov. 20, 1907 [6 days after inoculation].	47.0 cc. left half.	2758	Intrap.	Left	10.0 cc.	D.	72 days	Severe general tuberculosis.
		2759	"	"	10.0 cc.	K.	73 days	General tuberculosis of moderate severity.
	77.0 cc. right half.	2760	"	Right	10.0 cc.	K.	79 days	No tuberculosis.
		2761	"	"	10.0 cc.	K.	79 days	No tuberculosis.
Nov. 21, 1907 [7 days after inoculation].	28.0 cc. left half.	2764	Intrap.	Left	10.0 cc.	D.	73 days	General tuberculosis of moderate severity.
		2765	"	"	Centrifuged deposit of 18.0 cc. emulsified in saline.	D.	86 days	General tuberculosis.
	45.0 cc. right half.	2766	"	Right	10.0 cc.	D.	12 days	Slight pseudo-tuberculosis. No sign of tuberculosis.
		2767	"	"	Centrifuged deposit of 35.0 cc. emulsified in saline.	K.	130 days	Slight general tuberculosis.
Nov. 22, 1907 [8 days after inoculation].	20.0 cc. left half.	2770	Intrap.	Left	10.0 cc.	K.	112 days	General tuberculosis, not severe.
		2771	"	"	10.0 cc.	D.	102 days	General tuberculosis.
	60.0 cc. right half.	2772	"	Right	10.0 cc.	K.	112 days	General tuberculosis, not severe.
		2773	"	"	10.0 cc.	K.	112 days	No tuberculosis.
Nov. 28, 1907 [14 days after inoculation].	40.0 cc. left half.	2789	Intrap.	Left	10.0 cc.	D.	99 days	General tuberculosis.
		2790	"	"	10.0 cc.	D.	104 days	General tuberculosis.
	117.0 cc. right half.	2791	"	Right	10.0 cc.	D.	88 days	Severe general tuberculosis.
		2792	"	"	10.0 cc.	K.	101 days	Chronic general tuberculosis.
Dec. 5, 1907 [21 days after inoculation].	67.0 cc. left half.	2831	Intrap.	Left	6-7.0 cc.	D.	95 days	Severe general tuberculosis.
	40.0 cc. right half.	2832	"	Right	Centrifuged deposit of 40.0 cc.	K.	116 days	General tuberculosis.
Jan. 28, 1908 [75 days after inoculation].	About 0.5 cc. left half.	2920	Intrap.	Left	About 0.5 cc.	K.	62 days	Early slight general tuberculosis.
	About 1.5 cc. right half.	2921	"	Right	About 1.5 cc.	K.	58 days	Chronic general tuberculosis.

GUINEA-PIGS INOCULATED WITH THE FAECES OF GOAT 55.

Date.	No. of Guinea-pig.	Mode of Injection.	Dose of Faeces.	Killed or Died.	Duration of Life.	Result.
Nov. 16, 1907 [2 days after inoculation].	2734	Intrap.	1.0 cc.	Emulsion of Faeces—1 in 20 dilution. { D. D.	6 days	The cause of death was not apparent.
	2735	"	1.0 cc.		6 days	
Nov. 18, 1907 [4 days after inoculation].	2746	Intrap.	1.0 cc.	Do. do. { D. D.	7 days	The cause of death was not apparent. An acute infection.
	2747	"	1.0 cc.		2 days	
Nov. 21, 1907 [7 days after inoculation].	2768	Intrap.	1.0 cc.	Do. do. { K. K.	130 days	No tuberculosis.
	2769	"	1.0 cc.		130 days	" "
Nov. 23, 1907 [9 days after inoculation].	2774	Intrap.	1.0 cc.	Do. do. { K. K.	111 days	No tuberculosis.
	2775	"	1.0 cc.		111 days	" "

RABBITS INOCULATED WITH CULTURE DERIVED FROM THE MILK OF GOAT 55
THROUGH GUINEA-PIG 2791.

Date of Inoculation.	Immediate Source of Culture.	Dose in Milligrammes.	No. of Rabbit.	Mode of Inoculation.	Killed or Died.	Duration of Life.	Result.
Aug. 14, 1908.	The culture was obtained from G.P. 2791, inoculated on Nov. 28, 1907, with 10.0 cc. of milk from the right half of the udder. The 7th generation 11 days old was used for inoculation.	1.0 mg.	1967	Intrav.	K.	167 days	Tuberculosis of lungs and kidneys.
		0.1 mg.	1968	Intrav.	K.	167 "	Very slight tuberculosis of lungs and kidneys.
		0.01 mg.	1969	Intrav.	K.	167 "	Very slight tuberculosis of lungs and kidneys.
		50.0 mg.	1970	Subcut.	K.	167 "	Local lesion, a moderate number of caseating nodules in lungs, and one minute grey tubercle in one kidney.

EXPERIMENT G.

GOAT 59 [Adult Female].

Subcutaneous inoculation of culture derived from a tuberculous lung (Virus H 79. "J.N").

Dose—100.0 milligrammes.

Date of Inoculation—November 28, 1907

Killed when in good health—March 13, 1908. [106 days after inoculation.]

Clinical Notes.

At the close of the first week after inoculation there was a large somewhat flattened and firm tumour measuring 9 by 5 cm. at the seat of inoculation with rather ill-defined margins; the skin over it was hot and slightly tender. The adjacent prescapular gland was enlarged, measuring 5 cm. in diameter.

For the previous two or three days the appetite had not been so good and the goat was losing flesh; the milk was diminished in amount. The respiration was not increased.

The tumour subsequently became soft and fluctuating, and then opened and discharged. The goat quickly improved in general health, and was quite well during the last two months of the experiment.

Temperature.

The temperature rose to 40·6° C. on the 5th day after inoculation ; it was raised and irregular for a period of six weeks, the temperature varying for the most part between 39·0° and 40·0° C. Subsequently it remained normal.

Tuberculin Tests.

February 21, 1908. [85 days after inoculation.] 1·0 cc. tuberculin (human). Reacted. Rise of temperature, 1·8° C.

March 4, 1908. [97 days after inoculation.] 4·0 cc. tuberculin (avian). Reacted. Rise of temperature, 1·8° C.

Weights.

grs. lbs.

November 28, 1907	...	...	...	3	0
March 13, 1908	...	...	...	3	2

Total gain of weight.—2 lbs.

POST-MORTEM EXAMINATION.

The carcass was in good condition.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a scar measuring 5 by 1·5 cm. in area ; on section through it the subcutaneous tissues under and for a short distance around it were slightly thickened and beset with yellow caseo-calcareous tubercles varying in size from a pin's head to a hemp seed.

Left Prescapular Gland.—The left prescapular gland was enlarged, measuring 3 by 2 by 1·5 cm. ; the major part of its substance was occupied by an oval firm caseous mass slightly gritty from calcification.

Right Prescapular Gland (3 by 1·7 by 0·8 cm.).—Normal on section.

Prepectoral, Cervical, and Axillary Glands.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were pink and collapsed normally ; on the dorsal surface of each caudal lobe there were several firm slightly projecting greyish patches which extended into the lung substance for some distance (similar to those in Goat 55) ; elsewhere the lung parenchyma showed fairly numerous more or less discrete translucent grey tubercles varying up to about 1·5 mm. in diameter, several of which showed in the centre a minute soft whitish focus.

The patches in the caudal lobes were undoubtedly parasitic in origin ; the separate tubercles were probably also caused by parasites, though these were not detected in smear preparations.

Bronchial and Mediastinal Glands.—Normal.

Heart.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—Normal.

Liver.—One miliary tubercle with a minute opaque white centre was seen in the substance of the liver just under the capsule.

Portal Glands.—Normal.

Kidneys.—The kidneys showed on the surface a number of pale grey spots of various sizes, these penetrated the cortex as radial streaks ; the majority

were obviously not tuberculous, but a few showed a whitish focus or two, and without microscopical examination a decision as to the nature of these could not have been made.

Suprarenal Bodies.—Normal.

Iliac Glands.—One of the left iliac glands showed in the cortex an irregular caseous gritty patch 5 mm. in diameter.

Renal and Lumbar Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Submaxillary Glands.—The left contained a caseous gritty focus ; the right was normal.

Intestines.—Normal.

Mesenteric Glands.—All the mesenteric glands were tuberculous ; the large one at the posterior end showed several patches composed of a coarse yellow caseous slightly gritty network ; the rest of the glands contained scattered discrete irregular caseous foci and streaks, some just perceptibly gritty.

Ileo-Colic Glands.—All the ileo-colic glands contained discrete irregular caseous tubercles.

The tubercles in these and the mesenteric glands were situated at the outer margin of the cortex just under the capsule.

Genito-Urinary System.

Mammary Gland.—The gland was cut up into thin longitudinal strips, but no tubercles were seen. There was no milk in the sinuses or ducts.

Supramammary lymphatic Glands.—Normal.

Peripheral Lymphatic Glands.

Precurral, Popliteal, Gluteal, Ischiatic.—Normal.

On the right side of the neck at the site of inoculation of tuberculin (*see above*) there was a small firm swelling ; on section the swelling was caused by a layer of fibrous tissue, mottled with hæmorrhages, between the muscles, which were oedematous.

Microscopical Examination.

(Smears from :—)

Submaxillary Gland (caseous focus).—No tubercle bacilli seen.

Mesenteric Gland (caseous patch).—No tubercle bacilli seen.

Kidney (whitish focus).—Tubercle bacilli, few seen.

Lung (firm patch in caudal lobe).—Numerous embryos of the filiaræ.

Lung (soft central foci of small tubercles, 2 smears).—No tubercle bacilli seen.

Tuberculin Swelling.—Tubercle bacilli moderately numerous. (These bacilli were no doubt inoculated with the tuberculin ; *see* result of guinea-pig inoculation with an emulsion of the swelling.)

Animals Inoculated.

Guinea-pig 3000 was inoculated intraperitoneally with an emulsion of the tuberculin swelling ; and Guinea-pig 3001 intraperitoneally with an emulsion of spleen. The former died in 54 days, the latter in 49 days ; neither showed any sign of tuberculosis.

GUINEA-PIGS INOCULATED WITH THE MILK OF GOAT 59.

Date.	Total yield of milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Nov. 28, 1907 [before inoculation].		2793	Intrap.	Left	10.0 cc.	K.	95 days	Healthy.
		2794	"	Right	10.0 cc.	"	"	Healthy.
		2795	"	Left and Right (mixed).	10.0 cc.	"	"	Healthy.
Nov. 29, 1907 [24 hours after inoculation].	Left half 202.0 cc.	2796	Intrap.	Left	10.0 cc.	K.	55 days	General tuberculosis.
		2797	"	"	Centrifuged deposit of 96.0 cc.	"	"	General tuberculosis.
		2799	"	"	Do. do.	"	"	General tuberculosis.
	Right half 202.0 cc.	2798	"	Right	10.0 cc.	"	"	Early general tuberculosis.
		2800	"	"	Centrifuged deposit of 96.0 cc.	"	"	General tuberculosis.
		2801	"	"	Do. do.	"	"	General tuberculosis.
Nov. 30, 1907 [2 days after inoculation].	Left half 114.0 cc.	2807	Intrap.	Left	10.0 cc.	D.	75 days	Severe general tuberculosis.
		2808	Intrap. and partly Subcut.	"	10.0 cc.	D.	75 days	Severe general tuberculosis.
	Right half 104.0 cc.	2809	Intrap.	Right	10.0 cc.	D.	87 days	General tuberculosis.
		2810	"	"	10.0 cc.	D.	80 days	General tuberculosis.
Dec. 2, 1907 [4 days after inoculation].	Left half 70.0 cc.	2811	Intrap.	Left	Centrifuged deposit of 35.0 cc.	D.	109 days	General tuberculosis.
		2812	"	"	Do. do.	K.	113 days	General tuberculosis.
	Right half 74.0 cc.	2813	"	Right	Centrifuged deposit of 37.0 cc.	D.	89 days	General tuberculosis.
		2814	"	"	Do. do.	D.	90 days	General tuberculosis.
Dec. 3, 1907 [5 days after inoculation].	Left half 75.0 cc.	2821	Intrap.	Left	10.0 cc.	D.	58 days	General tuberculosis.
	Right half 50.0 cc.	2822	"	Right	10.0 cc.	K.	112 days	General tuberculosis.
Dec. 4, 1907 [6 days after inoculation].	Left half 38.0 cc.	2827	Intrap.	Left	Centrifuged deposit of 19.0 cc.	D.	109 days	General tuberculosis.
		2828	"	"	Do. do.	D.	97 days	Severe general tuberculosis.
	Right half 40.0 cc.	2829	"	Right	Centrifugal deposit of 20.0 cc.	D.	73 days	General tuberculosis.
		2830	"	"	Do. do.	D.	72 days	General tuberculosis not very severe

EXPERIMENT H.

GOAT 69 [Adult Female].

Subcutaneous inoculation of culture derived from cerebro-spinal fluid through Guinea-pig 2878 (Virus H 98. "B.R.")

Dose—10.0 milligrammes.

Date of Inoculation—June 3, 1908.

Killed when in good health—September 25, 1908. [114 days after inoculation.]

Clinical Notes.

On June 5, two days after inoculation, the centrifuged deposit of milk from the right and the left halves of the udder was examined microscopically. No tubercle bacilli were seen in that from the left

half, one bacillus stained red was found in that from the right.

On June 17, the centrifuged deposit of milk was again examined; no tubercle bacilli were seen in that from the left half, five long tubercle bacilli were seen in that from the right.

On July 15 (42 days after inoculation) before withdrawing the milk for the inoculation of guinea-pigs, the udder was noticed to be enlarged: on palpation the right side was found to be uniformly enlarged, knotty, and indurated; the left side was not obviously enlarged but contained some hard nodules just above the teat. An enlarged supramammary lymphatic gland was felt on the right side. The milk was much diminished in amount (only about 5 cc. being obtained from the right half and 14 cc. from the left half), but showed no alteration in quality.

On July 15 culture tubes were sown from the milk of each half, and pure cultures of tubercle bacilli were obtained, the colonies being more numerous on the tube sown with milk from the right side than on that sown with milk from the left side.

The general health of the animal was good.

On July 31 a few drops of milk were obtained from the right side of the mamma, and about 1.0 cc. from the left. No tubercle bacilli were found in smear preparations made from either of the samples.

On September 24 both sides of the udder were still indurated, but had decreased in size.

The goat was in good health when killed on September 25.

Temperature.

On the 45th day after inoculation the temperature rose to 39.5° C. and reached a maximum of 39.8° C. on the 50th day: it was raised during 10 days in all (July 18-28). With this exception, the temperature remained approximately normal, though somewhat irregular, during the experiment.

Tuberculin Test.

August 18, 1908. [76 days after inoculation.]
Dose, 1.0 cc. Reacted. Rise, 1.8° C.

Weights.

				qrs.	lbs.
June 3, 1908...	...	...	...	2	22
September 25, 1908 ...	...	...	...	2	21

POST-MORTEM EXAMINATION.

The carcass was in good condition.

Local Lesion.—In the subcutaneous tissues at the seat of inoculation on the left side of the neck there was a softened caseous encapsuled mass rather less than a pigeon's egg in size; the capsule was adherent to the skin but not to the muscles; it was about 1 mm. thick and lined internally with granulation tissue.

Left Prescapular Gland.—The left prescapular gland was the same size as the right, and was normal on section.

Right Prescapular Gland.—Normal.

Pectoral and Axillary Glands.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—On the dorsal surface of each caudal lobe there were many irregular firm reddish patches which on section were found to extend a short distance into the substance of the lung; the patches were due to parasites, numerous embryos of the filaria being found in a smear preparation; no tubercles were seen in the lung.

Bronchial and Mediastinal Gland.—Normal.

Heart.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen, Liver, Kidneys, and Suprarenal Bodies.—Normal.

Portal, Coeliac, Lumbar, and Iliac Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Submaxillary and Retro-pharyngeal Glands.—Normal.

Intestines and Mesenteric Glands.—Normal.

Mammary Gland.—The mammary tissue felt indurated and nodular, particularly in the posterior parts; the right half of the gland was larger than the left, which was on the whole probably not much larger than it should be.

On removal the upper surfaces showed several irregular spherical nodules which were fibrous-walled cysts containing a substance resembling cream cheese; at the outer margin of each half of the mamma there was a thin-walled cyst containing about a cubic centimetre or more of milky-white fluid.

On section the tissue of the right half of the mamma was very tough and fibrous and beset with shotty tubercles from 1 to 1.5 mm. in diameter which stood up from the cut surface; these tubercles had fibrous margins and yellow centres which in the majority of cases were calcareous or caseo-calcareous and in a few caseous and softened; towards the posterior part there was a yellow caseo-calcareous nodule the size of a wheat-grain. The left half of the mamma was similar to the right, but the tubercles were not so numerous.

The milk sinuses contained a small quantity of turbid or pale milky watery fluid; some of this was pipetted from each sinus through the teat before the mamma was cut into and cultures sown; the mucous membrane of the sinuses was normal.

Supramammary Lymphatic Glands.—Both supramammary lymphatic glands were enlarged, the left only slightly, the right was about twice the size of the left; on section the tissue of both was oedematous, but there was no sign of tuberculosis.

Various Lymphatic Glands.

Precrural, Popliteal, Gluteal, Ischiatic, Cervical.—Normal.

Microscopical Examination.

Smear from Reddish Patch in Lung.—No tubercle bacilli. Numerous embryos of the filaria.

Smear from Popliteal Gland.—No tubercle bacilli.

Smear from Distended Alveolus in Left Mamma.—No tubercle bacilli seen.

Smear from Distended Alveolus in Right Mamma.—No tubercle bacilli seen.

Smear from Caseo-calcareous Nodule in Right Mamma.—No tubercle bacilli seen. A few diplobacilli.

Smear from Several Miliary Tubercles from Right Mamma.—Three tubercle bacilli seen.

Milky fluid from Left Sinus.—No tubercle bacilli seen.

Milky fluid from Right Sinus.—One (?) tubercle bacillus seen.

Animal Inoculated.

Guinea-pig 3287 was inoculated intraperitoneally with an emulsion of the right supramammary gland.

It was killed after 49 days and showed slight general tuberculosis.

GUINEA-PIGS INOCULATED WITH THE MILK OF GOAT 69.

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
June 3, 1908 [before inoculation].		3093	Intrap.	Left	10.0 cc.	K.	83 days	Healthy.
		3094	"	Right	10.0 cc.	K.	83 "	"
		3095	"	Left and Right.	About 9.0 cc.	K.	83 "	"
June 4, 1908 [24 hours after inoculation].	Left half 70.0 cc.	3096	Intrap.	Left	20.0 cc.	K.	37 days	No tuberculosis.
		3097	"	"	10.0 cc.	K.	70 "	" "
	Right half 50.0 cc.	3098	"	Right	20.0 cc.	K.	37 "	" "
		3099	"	"	10.0 cc.	K.	70 "	" "
June 5, 1908 [48 hours after inoculation].	Left half 150.0 cc.	3100	Intrap.	Left	Centrifuged deposit of 30.0 cc. plus 10.0 cc. of uncentrifuged milk. Centrifuged deposit of 30.0 cc. plus 10.0 cc. of uncentrifuged milk.	K.	70 days	No tuberculosis.
		3101	"	"		K.	70 "	" "
	Right half 153.0 cc.	3102	"	Right		K.	70 "	" "
		3103	"	"		K.	70 "	" "
June 6, 1908 [3 days after inoculation].	Left half 77.0 cc.	3105	Intrap.	Left	10.0 cc.	K.	72 days	No tuberculosis.
		3106	"	"	10.0 cc.	K.	72 "	" "
	Right half 100.0 cc.	3107	"	Right	10.0 cc.	K.	72 "	" "
		3108	"	"	10.0 cc.	K.	72 "	" "
June 8, 1908 [5 days after inoculation].	Left half 34.0 cc.	3109	Intrap.	Left	10.0 cc.	K.	70 days	No tuberculosis.
		3110	"	"	10.0 cc.	K.	70 "	" "
	Right half 104.0 cc.	3111	"	Right	10.0 cc.	K.	70 "	" "
		3112	"	"	10.0 cc.	K.	70 "	" "
June 10, 1908 [7 days after inoculation].	Left half 62.0 cc.	3113	Intrap.	Left	10.0 cc.	K.	69 days	No tuberculosis.
		3114	"	"	10.0 cc.	K.	69 "	" "
	Right half 157.0 cc.	3115	"	Right	10.0 cc.	K.	69 "	" "
		3116	"	"	10.0 cc.	K.	69 "	" "
June 17, 1908 [14 days after inoculation].	Left half 60.0 cc.	3129	Intrap.	Left	Centrifuged deposit of 30.0 cc. each.	K.	78 days	Chronic general tuberculosis, not severe.
		3130	"	"		K.	78 "	No tuberculosis.
	Right half 60.0 cc.	3131	"	Right	Centrifuged deposit of 30.0 cc. each.	K.	78 "	Chronic general tuberculosis.
		3132	"	"		K.	78 "	Chronic general tuberculosis, not severe.
June 24, 1908 [21 days after inoculation].	Left half 45.0 cc.	3133	Intrap.	Left	10.0 cc.	K.	84 days	Chronic general tuberculosis.
		3134	"	"	10.0 cc.	K.	84 "	Chronic general tuberculosis.
	Right half 60.0 cc.	3135	"	Right	10.0 cc.	K.	84 "	Chronic general tuberculosis.
		3136	"	"	10.0 cc.	K.	84 "	Chronic general tuberculosis.
July 1, 1908 [28 days after inoculation].	Left half 89.0 cc.	3137	Intrap.	Left	10.0 cc.	D.	64 days	Severe general tuberculosis.
		3138	"	"	10.0 cc.	K.	77 "	Chronic general tuberculosis.
	Right half 86.0 cc.	3139	"	Right	10.0 cc.	D.	75 "	General tuberculosis.
		3140	"	"	10.0 cc.	K.	77 "	Chronic general tuberculosis.
July 17, 1908 [44 days after inoculation].	Left half 14.0 cc.	3155	Intrap.	Left	About 7.0 cc.	D.	35 days	General tuberculosis.
		3156	"	"	" "	D.	19 "	General tuberculosis.
	Right half 5.0 cc.	3153	"	Right	About 2.5 cc.	D.	22 "	General tuberculosis.
		3154	"	"	" "	K.	71 "	General tuberculosis.

EXPERIMENT I.

GOAT 61 [Adult Female].

Subcutaneous inoculation of culture derived from the original material of Virus H. 109 "M.W." (lupus), through Guinea-pig 3002.

Dose—1.0 milligramme.

Date of Inoculation—July 27, 1908.

Killed when in good health—February 9, 1909. [197 days after inoculation.]

Clinical Notes.

The goat remained well after the inoculation. A small elongated tumour developed at the seat of inoculation on the left side of the neck, which afterwards disappeared, and the adjacent prescapular gland was slightly enlarged for a few weeks.

The milk was inoculated into guinea-pigs at intervals during the experiment (*see table*). Centrifuged deposit from the milk of each side of the udder was examined microscopically on two occasions, August 4 and October 7; no tubercle bacilli were seen.

On the latter date cultures were attempted, two egg tubes being sown with the centrifuged deposit of the milk from each side of the udder; all the tubes remained sterile.

Nothing abnormal was felt in the mammary gland during the experiment.

The goat had given birth to a kid ten weeks before her inoculation; the kid, No. 71, was permitted to suck its mother from August 13 (17 days after her inoculation) until January 14, 1909.

Temperature.

The temperature was a little raised for a period of 47 days commencing eighteen days after the inoculation; it averaged about 39.3° C.; on one occasion 40.0° C. and on another 40.3° C. was recorded. Subsequently the temperature was approximately normal.

Tuberculin Tests

November 4, 1908. [100 days after inoculation.] Dose, 1.0 cc. Reacted. Rise of temperature, 2.1° C.

January 7, 1909. [164 days after inoculation.] Dose, 1.0 cc. Reacted. Rise of temperature, 1.9° C.

Weights.

			qrs.	lbs.
July 27, 1908	...	...	3	14
February 9, 1909...	...	...	3	17

Total gain of weight.—3 lbs.

POST-MORTEM EXAMINATION.

The carcass was in good condition

Local Lesion.—In the subcutaneous tissues at the seat of inoculation there were two nodules with fibrous walls and creamy caseo-purulent contents; one was the size of a hemp seed, the other was slightly larger; in the muscles near these there was a similar nodule the size of a hemp seed.

Left Prescapular Gland.—The left prescapular gland was normal in size and showed no lesions on section.

Lungs.—On the dorsal surface of each caudal lobe in the posterior part there were several firm grey patches and in the rest of the lungs isolated grey nodules caused by filariae. There were no definite tuberculous lesions.

Mesenteric Glands.—In the cortex of one a minute greenish-yellow focus was seen.

Mammary Gland.—Normal.

All other organs and glands were examined and found normal.

GUINEA-PIGS INOCULATED WITH THE MILK OF GOAT 61.

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
July 27, 1908 [Before inoculation].	—	3176	Intrap.	Right	10.0 cc.	K.	124 days	Healthy.
		3177	"	Left	10.0 cc.	K.	124 "	"
		3178	"	Right and left.	10.0 cc.	K.	124 "	"
July 28, 1908 [24 hours after inoculation].	Both halves 840.0 cc.	3179	Intrap.	Lef	10.0 cc. (Milk with- drawn by hand).	K.	66 days	No tuberculosis.
		3180	"	"	"	K.	66 "	" "
		3181	"	Right	"	K.	66 "	" "
		3182	"	"	"	K.	66 "	" "

GUINEA-PIGS INOCULATED WITH THE MILK OF GOAT 61—continued.

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
July 30, 1908 [3 days after inoculation].	—	3187	Intrap.	Left	10·0 cc.	K.	68 days	No tuberculosis.
		3188	"	"	"	K.	68 "	" "
		3189	"	Right	"	K.	68 "	" "
		3190	"	"	"	K.	68 "	" "
August 1, 1908 [5 days after inoculation].	Both halves 390·0 cc.	3195	Intrap.	Left	10·0 cc.	K.	72 days	No tuberculosis.
		3196	"	"	"	K.	72 "	" "
		3193	"	Right	"	K.	72 "	" "
		3194	"	"	"	K.	72 "	" "
August 4, 1908 [8 days after inoculation].	Left half 177·0 cc.	3197	Intrap.	Left	10·0 cc.	K.	69 days	No tuberculosis.
		3198	"	"	"	K.	69 "	" "
	Right half 170·0 cc.	3199	"	Right	"	K.	69 "	" "
		3200	"	"	"	K.	69 "	" "
August 12, 1908 [16 days after inoculation].	Left half 175·0 cc.	3209	Intrap.	Left	10·0 cc.	K.	69 days	No tuberculosis.
		3210	"	"	"	K.	69 "	" "
	Right half 122·0 cc.	3207	"	Right	"	K.	69 "	" "
		3208	"	"	"	K.	69 "	" "
August 26, 1908 [30 days after inoculation].	—	3226	Intrap.	Left	10·0 cc.	K.	62 days	No tuberculosis.
		3227	"	"	"	K.	62 "	" "
		3228	"	Right	"	K.	62 "	" "
		3229	"	"	"	K.	62 "	" "
Sept. 16, 1908 [51 days after inoculation].	—	3273	Intrap.	Left	10·0 cc.	K.	69 days	No tuberculosis.
		3274	"	"	"	K.	69 "	" "
		3271	"	Right	"	K.	69 "	" "
		3272	"	"	"	K.	69 "	" "
Sept. 30, 1908 [65 days after inoculation].	—	3307	Intrap.	Left	10·0 cc.	K.	83 days	No tuberculosis.
		3308	"	"	"	K.	83 "	" "
		3305	"	Right	"	D.	73 "	" "
		3306	"	"	"	K.	83 "	" "
Oct. 26, 1908 [91 days after inoculation].	—	3335	Intrap.	Left	10·0 cc.	K.	101 days	No tuberculosis.
		3336	"	"	"	K.	101 "	" "
		3337	"	Right	"	K.	101 "	" "
		3338	"	"	"	K.	101 "	" "
Nov. 5, 1908 [101 days after inoculation].	—	3347	Intrap.	Left	10·0 cc.	K.	93 days	No tuberculosis.
		3348	"	Right	"	K.	93 "	" "
Nov. 6, 1908 [102 days after inoculation].	—	3353	Intrap.	Left	10·0 cc.	K.	105 days	No tuberculosis.
		3354	"	"	"	K.	105 "	" "
		3351	"	Right	"	K.	105 "	" "
		3352	"	"	"	K.	105 "	" "

GUINEA-PIGS INOCULATED WITH THE MILK OF GOAT 61—*continued.*

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Jan. 6, 1909 [163 days after inoculation].	—	3425	Intrap.	Left	10.0 cc.	K.	69 days	No tuberculosis.
		3426	"	"	"	K.	69 "	" "
		3423	"	Right	"	K.	69 "	" "
		3424	"	"	"	K.	69 "	" "
Feb. 9, 1909 [197 days after inoculation].	Left half 8.0 cc.	3460	Intrap.	Left	4.0 cc.	K.	42 days	No tuberculosis.
		3461	"	"	4.0 cc.	K.	42 "	" "
	Right half 9.0 cc.	3458	"	Right	5.0 cc.	K.	42 "	" "
		3459	"	"	4.0 cc.	K.	42 "	" "

KID 71.

(Ten weeks old.)

SUCKING GOAT 61.

Duration of experiment—The kid was placed with Goat 61 on August 13, 1908, 17 days after her inoculation, and continued sucking until January 14, 1909, a period of 154 days; on this day the kid was killed.

Clinical Notes.

The kid remained well and grew normally during the experiment.

Tuberculin Tests.

No. 1. November 4, 1908. [83 days after commencement of experiment.] Dose, 1.0 cc. No reaction. Rise of temperature, 0.3° C.

No. 2. January 7, 1909. [147 days after inoculation.] Dose, 1.0 cc. Rise of temperature, 0.8 C.

Weights.

	grs.	lbs.
August 13, 1908 ...	1	6
January 14, 1909 ...	2	9

Total gain of weight.—1 qr. 3 lbs.

POST-MORTEM EXAMINATION.

The carcass was in good condition.

All the organs and glands were examined and were found free from tuberculosis.

EXPERIMENT J.

GOAT 81 [Adult Female].

Intravenous inoculation of culture derived from the original material of Virus H. 115. "N.G." through Guinea-pig 3087.

Dose—2.0 milligrammes.

Date of Inoculation—December 18, 1908.

Died—January 28, 1909. [41 days after inoculation.]

Clinical Notes.

The goat was first noticed to be ill during the second week in January; she lost appetite, was quiet, and looked seedy and depressed. The loss of appetite continued, the respiration became quickened, and the goat gradually became very weak and emaciated; death ensued on the 41st day after inoculation.

Milk was withdrawn from the udder by hand (the ducts of the teats being too narrow to admit a cannula) at intervals from December 18 (the day of inoculation) until January 2 and inoculated into guinea-pigs;

after this date the udder was dry and no milk could be obtained.

On January 2 milk from both halves of the udder was centrifuged and the deposit examined microscopically; no tubercle bacilli were seen.

On January 28, after death, 10.0 cc. of saline were injected into the milk sinuses of each half of the mamma. After manipulating the mamma some milky fluid was withdrawn. Microscopical examination of the fluid from each half of the mamma showed no tubercle bacilli; the fluid was inoculated into guinea-pigs.

Temperature.

The temperature was raised and irregular during the whole period of the experiment (maximum 40·4° C., minimum 38·3° C.).

Weights.

	qrs.	lbs.
December 18, 1908... ..	2	20
January 28, 1909	2	0

Total loss of weight.—20 lbs.

POST-MORTEM EXAMINATION.

The carcass was emaciated.

Local Lesion.—In the muscles near the middle of the left jugular vein there was a small collection of caseo-pus; the vein itself was normal.

Thorax.

Lungs.—The greater part of the right cephalic lobe, the whole of the right middle, the ventral portions of the left cephalic lobes, and the antero-ventral portions of the caudal lobes were firm, reddish and airless; the rest of the lung was congested, air-containing, but much firmer and less crepitant than normal.

The consolidated tissue showed on section greyish areas surrounded by reddish tissue, many of the grey areas (which probably corresponded to lobules) having irregular ill-defined yellowish centres.

The crepitant parts of the lungs were closely beset with grey almost transparent miliary tubercles.

Thoracic Glands.—The bronchial and dorsal mediastinal glands were much enlarged and congested; they were composed of reddish tissue mottled with small translucent grey areas; there was no sign of caseation.

Heart.—Normal.

Abdomen.

Spleen.—The spleen was soft, no tubercles were seen on the surface or on section.

Liver.—The liver was pale and firm, no tubercles were seen on the surface or on section.

Kidneys.—Normal.

Mesenteric Glands.—In one there was a large pea-sized calcareous nodule (not tuberculous).

Mammary Gland.—The mammary gland was small, the gland substance was tough, and showed on section about half a dozen yellow bodies each about 1 mm. in diameter which stood up from the cut surface; when crushed they had a fibrous wall and milky or creamy contents; no tubercle bacilli were found in smear preparations made from two; they were probably of the nature of retention cysts. There was a small quantity of milky fluid in the milk sinuses. The mucous membrane was normal.

All other organs and glands were examined and found normal.

Microscopical Examination.

Scraping from Consolidated portion of Lung.—Tubercle bacilli numerous.

Scraping from Mediastinal Gland.—Sparsely-scattered tubercle bacilli.

Nodule from Mesenteric Gland.—No tubercle bacilli.

Soft focus from the Mamma.—No tubercle bacilli.

GUINEA-PIGS INOCULATED WITH MILK OF GOAT 81.

(The milk was withdrawn by hand.)

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Dec. 18, 1908 [before inoculation].		3399	Intrap.	Right	10·0 cc.	K.	169 days	Healthy.
		3400	"	Left	10·0 cc.	K.	169 "	"
Dec. 19, 1908 [24 hours after inoculation].	Right half 161·0 cc.	3401	Intrap.	Right	10·0 cc.	K.	51 days	General tuberculosis.
		3402	"	"	10·0 cc.	K.	51 "	Slight general tuberculosis.
		3403	"	"	10·0 cc.	K.	51 "	Slight general tuberculosis.
		3404	"	"	10·0 cc.	K.	51 "	Very slight general tuberculosis.
Dec. 20, 1908 [48 hours after inoculation].	Right half 190·0 cc.	3405	Intrap.	Right	10·0 cc.	K.	50 days	Slight general tuberculosis.
		3406	"	"	10·0 cc.	K.	50 "	Slight general tuberculosis.
		3407	"	"	10·0 cc.	K.	50 "	Early general tuberculosis.
		3408	"	"	10·0 cc.	K.	50 "	Very slight general tuberculosis.
Dec. 21, 1908 [3 days after inoculation].	Right half 187·0 cc.	3409	Intrap.	Right	10·0 cc.	K.	50 days	No tuberculosis.
		3410	"	"	10·0 cc.	K.	50 "	" "
	Left half 185·0 cc.	3411	"	Left	10·0 cc.	K.	50 "	" "
		3412	"	"	10·0 cc.	K.	50 "	General tuberculosis, not severe.

GUINEA-PIGS INOCULATED WITH MILK OF GOAT 81—*continued*.

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Dec. 26, 1908 [8 days after inoculation].	Right half	3413	Intrap.	Right	10.0 cc.	K.	77 days	No tuberculosis.
	170.0 cc.	3414	"	"	10.0 cc.	K.	77 "	Slight general tuberculosis.
	Left half	3415	"	Left	10.0 cc.	K.	77 "	General tuberculosis, moderately severe.
	170.0 cc.	3416	"	"	10.0 cc.	K.	77 "	Slight general tuberculosis.
Jan. 2, 1909 [15 days after inoculation].	Right half	3417	Intrap.	Right	10.0 cc.	K.	70 days	General tuberculosis.
	90.0 cc.	3418	"	"	10.0 cc.	K.	70 "	Slight general tuberculosis.
	Left half	3419	"	Left	10.0 cc.	K.	70 "	No tuberculosis.
	90.0 cc.	3420	"	"	10.0 cc.	K.	70 "	Slight general tuberculosis.

Early in January the udder became dry; January 2 was the last occasion on which milk was withdrawn.

On January 28, 1909, 10.0 cc. of saline were injected into the milk sinuses of each half of the mamma. After manipulating the mamma some milky fluid was withdrawn through the catheter used for injecting the saline, 4.0 cc. from the right side and 5.0 cc. from the left.

Jan. 28, 1909 [41 days after inoculation].		3436	Intrap.	Right	2.0 cc. of the fluid.	K.	47 days	General tuberculosis.
		3437	"	"	"	K.	47 "	General tuberculosis.
		3434	"	Left	2.5 cc. of the fluid.	D.	28 "	General tuberculosis.
		3435	"	"	"	D.	35 "	General tuberculosis.

EXPERIMENT K.

GOAT 75 [Young Adult Female].

Fed once with culture derived from the original material (synovial membrane of knee-joint) of Virus H. 76. "G.M." through Guinea-pig 2887.

Dose—74.0 milligrammes.

Date of Feeding—September 22, 1908.

Killed when in good health—August 16, 1909. [328 days after feeding.]

Clinical Notes.

On October 14, 22 days after feeding, centrifuged deposits of milk from the right and left halves of the udder were examined microscopically; no tubercle bacilli were seen in either. Culture tubes sown from the deposit remained sterile.

The goat gave birth to two kids on May 30, 1909, eight months after the commencement of the experiment; the kids sucked their mother for nearly two-and-a-half months, and when killed on August 10, 1909, were found to be perfectly healthy. The goat remained well during the experiment and was killed on August 16, 1909.

Temperature.

There was a very slight rise of temperature commencing 28 days after inoculation which lasted a week and reached a maximum of 40.0° C. With this exception the temperature was normal during the experiment.

Tuberculin Tests.

November 4, 1908. [43 days after inoculation.] Dose, 1.0 cc. Reacted. Rise of temperature 1.6° C.
January 7, 1909. [107 days after inoculation.] Dose, 1.0 cc. Reacted. Rise of temperature 2.0° C.

Weights.

			qrs.	lbs.
September 22, 1908	...	...	2	16
August 16, 1909	...	...	3	4

Gain of weight.—16 lbs.

POST-MORTEM EXAMINATION.

The carcass was in good condition.

Alimentary Tract.

Tongue, Pharynx, Tonsils.—Normal.

Submaxillary Glands.—In the cortex of the left there was a group of three or four small calcareous tubercles; the right was normal.

Retro-pharyngeal Glands.—In the right pharyngeal gland there was a calcareous tubercle and two calcareous grains; the left was normal.

Parotideal Glands.—The left contained a few minute calcareous grains; the right was normal.

Cervical Glands.—Normal.

Intestines.—Normal.

Mesenteric Glands.—The large terminal gland contained an irregular calcareous patch and a few

calcareous tubercles; one in the middle of the mesentery showed a millet-seed sized calcareo-caseous tubercle. Other mesenteric glands were normal.

Ileo-colic Glands.—Six out of seven glands were affected, but were not obviously enlarged; three contained rather large calcareo-caseous patches; two showed a calcareo-caseous nodule or two, and in the other there was a single hemp-seed sized caseous nodule.

Portal Glands.—One portal gland contained a calcareo-caseous nodule the size of a pea and a

millet-seed sized calcareous tubercle; other portal glands were normal.

Mammary Gland.—Normal.

There was no sign of tuberculosis elsewhere.

Microscopical Examination.

Smear from the Spleen Substance.—No tubercle bacilli.

Nodule from a Portal Gland.—A few tubercle bacilli.

GUINEA-PIGS INOCULATED WITH MILK OF GOAT 75.

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Sept. 22, 1908 [before inoculation].		3280	Intrap.	Left	10·0 cc.	K.	256 days	No tuberculosis.
		3281	"	Right	10·0 cc.	D.	118 "	No tuberculosis. Death during parturition.
		3282	"	Mixed milk.	10·0 cc.	K.	256 "	No tuberculosis.
Sept. 24, 1908 [48 hours after inoculation].	Left half 70·0 cc.	3283	Intrap.	Left	10·0 cc.	K.	72 days	No tuberculosis.
		3284	"	"	10·0 cc.	K.	72 "	" "
	Right half 50·0 cc.	3285	"	Right	10·0 cc.	K.	72 "	" "
		3286	"	"	10·0 cc.	K.	72 "	" "
Sept. 26, 1908 [4 days after inoculation].	Left half 91·0 cc.	3291	Intrap.	Left	10·0 cc.	K.	81 days	No tuberculosis.
		3292	"	"	10·0 cc.	K.	81 "	" "
	Right half 77·0 cc.	3293	"	Right	10·0 cc.	K.	81 "	" "
		3294	"	"	10·0 cc.	K.	81 "	" "
Sept. 28, 1908 [6 days after inoculation]	Left half 68·0 cc.	3297	Intrap.	Left	10·0 cc.	K.	79 days	No tuberculosis.
		3298	"	"	10·0 cc.	K.	79 "	" "
	Right half 67·0 cc.	3295	"	Right	10·0 cc.	K.	79 "	" "
		3296	"	"	10·0 cc.	K.	79 "	" "
Sept. 30, 1908 [8 days after inoculation].	Left half 82·0 cc.	3303	Intrap.	Left	10·0 cc.	K.	83 days	No tuberculosis.
		3304	"	"	10·0 cc.	K.	83 "	" "
	Right half 70·0 cc.	3301	"	Right	10·0 cc.	K.	83 "	" "
		3302	"	"	10·0 cc.	K.	83 "	" "
Oct. 2, 1908 [10 days after inoculation].	Left half 101·0 cc.	3309	Intrap.	Left	10·0 cc.	K.	96 days	No tuberculosis.
		3310	"	"	10·0 cc.	K.	96 "	" "
	Right half 61·0 cc.	3311	"	Right	10·0 cc.	K.	96 "	" "
		3312	"	"	10·0 cc.	K.	96 "	" "
Oct. 4, 1908 [12 days after inoculation].	Left half 70·0 cc.	3315	Intrap.	Left	10·0 cc.	K.	93 days	No tuberculosis.
		3316	"	"	10·0 cc.	K.	93 "	" "
	Right half 40·0 cc.	3313	"	Right	10·0 cc.	D.	81 "	" "
		3314	"	"	10·0 cc.	K.	93 "	" "
Oct. 6, 1908 [14 days after inoculation].	Left half 123·0 cc.	3319	Intrap.	Left	10·0 cc.	K.	92 days	No tuberculosis.
		3320	"	"	10·0 cc.	K.	92 "	" "
	Right half 80·0 cc.	3317	"	Right	10·0 cc.	K.	92 "	" "
		3318	"	"	10·0 cc.	K.	92 "	" "

GUINEA-PIGS INOCULATED WITH THE MILK OF GOAT 75—*continued*.

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Oct. 14, 1908 [22 days after inoculation].	Left half 80.0 cc.	3325	Intrap.	Left	10.0 cc.	K.	86 days	No tuberculosis.
		3326	"	"	10.0 cc.	K.	86 "	" "
	Right half 70.0 cc.	3327	"	Right	10.0 cc.	K.	86 "	" "
		3328	"	"	10.0 cc.	K.	86 "	" "
Oct. 28, 1908 [36 days after inoculation].	Left half 46.0 cc.	3341	Intrap.	Left	10.0 cc.	K.	98 days	No tuberculosis.
		3342	"	"	10.0 cc.	K.	98 "	" "
	Right half About 21.0 cc.	3339	"	Right	10.0 cc.	K.	98 "	" "
		3340	"	"	10.0 cc.	K.	98 "	" "
Nov. 6, 1908 [45 days after inoculation].	Left half 11.0 cc.	3350	Intrap.	Left	10.0 cc.	K.	92 days	No tuberculosis.
	Right half 2.0 cc.	3349	"	Right	2.0 cc.	K.	92 "	" "
June 7, 1909 [258 days after inoculation, 8 days after giving birth to two kids].	—	3777	Intrap.	Left	10.0 cc.	K.	77 days	No tuberculosis.
		3778	"	"	10.0 cc.	K.	77 "	" "
		3779	"	Right	10.0 cc.	K.	77 "	" "
		3780	"	"	10.0 cc.	K.	77 "	" "

RABBITS INOCULATED WITH MILK OF GOAT 75.

Date.	No. of Rabbit.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
Sept. 24, 1908 [48 hours after inoculation].	2016	Subcut. Intrap.	Left	40.0 cc. 10.0 cc.	K.	148 days	No tuberculosis.
	2017	Subcut.	Right	30.0 cc.	D.	19 "	No tuberculosis. The cause of death was not apparent.

ABSTRACTS OF THE CASES AND DETAILED RESULTS OF THE INVESTIGATIONS SUMMARISED IN PART II OF THE REPORT.

Case 1.—HEIFER-CALF 1479.

Subcutaneous inoculation of culture derived from a guinea-pig inoculated with an emulsion of a bronchial gland from Calf 1325 (3rd passage), Virus H. 79. "J.N."

Dose—100.0 milligrammes.

Age at Inoculation—6 months.

Killed when in good health—110 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

(For full details see the Report on Cases of Human Tuberculosis other than Lupus.)

There was a cyst at the seat of inoculation and the adjacent glands contained caseous gritty masses. The suprarenal bodies contained nearly two dozen calcareous tubercles. The mesenteric, ileo-colic, and a few other abdominal glands contained discrete calcareous

tubercles, the thoracic glands contained small calcareous patches. One supramammary gland contained a calcareous grain.

The mamma was normal.

Some saline was injected into each of the mammary sinuses and a small quantity of turbid fluid recovered from each. No tubercle bacilli were demonstrated in smear preparations made from the fluid.

GUINEA-PIGS INOCULATED.

—	No. of Guinea-pig.	Mode of Inoculation.	Dose.	Duration of Life.	Result.
Mixed fluids from the two fore-quarters of the mamma	3566	Intrap.	Small	K. 62 days	General tuberculosis.
	3567	"	"	K. 62 "	General tuberculosis.
Mixed fluids from the two hind-quarters	3568	Intrap.	Slightly larger.	D. 58 "	General tuberculosis.
	3569	"	"	K. 62 "	General tuberculosis.

Case 2.—HEIFER-CALF 1601.

Subcutaneous inoculation of culture derived from the original material of Virus H. 143. "L.L." through Guinea-pig 3536.

Dose—68·0 milligrammes.

Age at Inoculation—4 months.

Killed when in good health—91 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

(For full details see the Report on Cases of Human Tuberculosis other than Lupus.)

There was a cyst containing thin pus and caseo-necrotic masses at the seat of inoculation; the adjacent prescapular gland contained a fibro-caseous mass, and one left prepectoral gland was fibro-caseous throughout; and one cervical gland contained a caseo-calcareous nodule.

Half a dozen minute grey tubercles with calcareous centres were seen in the lungs, and each suprarenal

body contained seven or eight miliary caseous tubercles. A moderate number of minute caseous foci were seen in the ileo-colic glands.

The mamma and supramammary glands were normal.

Four cubic centimetres of saline solution were injected into each of the mammary sinuses and about 3 cc. of slightly milky fluid were recovered in each case. One or two tubercle bacilli were seen in smear preparations made from the fluids recovered from the left fore, right fore, and right hind quarters, none was seen in that from the left hind quarter.

GUINEA-PIGS INOCULATED.

—		No. of Guinea-pig.	Mode of Inoculation.	Dose.	Duration of Life.	Result.
With the fluids recovered from—	{ The left fore quarter ...	3931	Intrap.	3·0 cc.	K. 70 days	General tuberculosis.
	{ The left hind quarter ...	3933	„	„	D. 47 „	General tuberculosis.
	{ The right fore quarter ...	3930	„	„	K. 70 „	General tuberculosis.
	{ The right hind quarter...	3932	„	„	K. 70 „	General tuberculosis.

Case 3.—HEIFER-CALF 1461.

Subcutaneous inoculation of culture derived from the thoracic gland of Calf 1367 (3rd passage), Virus H. 53. "D.H." (a).

Dose—50·0 milligrammes.

Age at Inoculation—6 months.

Killed when in good health—111 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

(For full details see the Report on Lupus Viruses.)

There was a cyst at the seat of inoculation containing turbid fluid and caseo-necrotic masses. The adjacent prescapular gland was mainly composed of caseo-calcareous tissue. One prepectoral and one cervical gland were similarly affected.

In the thoracic glands there were a few scattered

calcareous foci. The right supramammary gland contained a group of three caseous and softened tubercles.

The milk sinuses contained a small quantity of opalescent fluid; in the fluid from one quarter a moderate number of tubercle bacilli were seen on microscopical examination. The mammary tissue was normal.

GUINEA-PIG INOCULATED.

—	No. of Guinea-pig.	Mode of Inoculation.	Duration of Life.	Result.
With a few drops of the fluid from one quarter of the mamma.	3476	Intrap.	Killed 33 days	Early general tuberculosis.

Case 4.—HEIFER-CALF 1535.

Subcutaneous inoculation of culture derived from the original material of Virus H 53. "D.H." (b), through Guinea-pig 3216.

Dose—50·0 milligrammes.

Age at Inoculation—About 3 months.

Killed when in good health—103 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

(For full details see the Report on Lupus Viruses.)

There was a large thin-walled cyst at the seat of inoculation containing caseo-pus and caseous masses; the adjacent prescapular gland was enlarged, dense, and caseous throughout. The lungs showed on the surface a very few minute calcareous tubercles and some minute grey foci; the spleen contained scattered calcareous tubercles.

The Peyer's patches of the small intestine contained altogether several yellow foci and three small ulcers, slightly calcareous; several small ulcers without caseation or calcification were also seen in the intestines. Nearly every lymphatic gland in the body contained caseous or calcareous tubercles or nodules more or less numerous.

The supramammary glands contained altogether 10 caseous gritty nodules up to 2 mm. in diameter.

The mamma was normal; the milk sinuses of the right fore quarter contained 2 or 3 cc. of purulent fluid; the fluid contained yellow shreds which were casts of the smaller ducts; on standing these fell to the bottom, leaving a slightly turbid supernatant fluid. On microscopical examination of the pus tubercle bacilli were found, sparsely scattered; one was seen inside a leucocyte. There was no pus in the other quarters of the udder.

A quantity of saline solution was injected into the left fore quarter and the hind quarters of the udder; with the fluids recovered from two of these quarters guinea-pigs were inoculated. No tubercle bacilli were seen in smear preparations of the fluids recovered from the hind quarters.

GUINEA-PIGS INOCULATED.

—	No. of Guinea-pig.	Mode of Inoculation.	Duration of Life.	Result.
With pus from the right fore quarter ...	3749	Intrap.	Died 77 days	Severe general tuberculosis.
With fluid recovered from the left fore quarter	3750	Intrap.	Killed 97 "	No tuberculosis.
With fluid recovered from the right hind quarter	3751	Intrap.	Killed 97 "	No tuberculosis.
	3752	Intrap.	Killed 97 "	No tuberculosis.

Case 5.—HEIFER-CALF 1571.

Subcutaneous inoculation of culture derived from the small mediastinal gland of Calf 1561 (1st passage) Virus H. 53. "D.H." (b).

Dose—50·0 milligrammes.

Age at Inoculation—3½ months.

Killed when in good health—111 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

(For full details see the Report on Lupus Viruses.)

There was a small fibrous-walled cyst with caseous and softened contents at the seat of inoculation. The adjacent prescapular gland was extensively caseo-calcareous and softened, one cervical gland showed a calcareous patch, and one prepectoral gland a calcareous focus. There were three small tubercles in the spleen and a caseous gritty nodule in one suprarenal body.

Two thoracic and five abdominal glands each contained one or more minute calcareous or caseous foci.

The mamma, and supramammary glands, were normal.

Three cubic centimetres of saline solution were injected into each of the mammary sinuses and about 1 cc. of very slightly milky fluid was recovered in each case. No tubercle bacilli were seen in these fluids on microscopical examination.

GUINEA-PIGS INOCULATED.

—		No. of Guinea-pig.	Mode of Inoculation.	Dose.	Duration of Life.	Result.
With the fluids recovered from—	The left fore quarter ...	3907	Intrap.	Rather less than 1·0 cc.	K. 62 days	No tuberculosis.
	The left hind quarter ...	3905	„	„	K. 62 „	No tuberculosis.
	The right fore quarter ...	3904	„	„	D. 13 „	No tuberculosis.
	The right hind quarter...	3906	„	„	K. 62 „	No tuberculosis.

Case 6.—HEIFER-CALF 1505.

Subcutaneous inoculation of culture derived from the lung of Calf 1453, Virus H 107. "H.H."

Dose—100·0 milligrammes.

Age at Inoculation—5 months.

Killed when in good health—101 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

mamma and the supramammary lymphatic glands were normal.

(For full details see the Report on Lupus Viruses.)

There was a small fibroid local tumour containing a cavity filled with caseo-pus; the adjacent prescapular gland and one prepectoral gland were fibro-caseo-calcareous. Scattered ulcerated nodules containing yellow pus (smear, T.B.) were seen in the small intestine; there was one in the large intestine. The

Some saline was injected into each of the mammary sinuses and a small quantity of slightly turbid fluid recovered from each. No tubercle bacilli were seen in the mixed fluids from the two fore quarters or in that from the two hind quarters on microscopical examination.

GUINEA-PIGS INOCULATED.

	No. of Guinea-pig.	Mode of Inoculation.	Dose.	Duration of Life.	Result.
Mixed fluids from the fore-quarters of the mamma	3707	Intrap.	2·0 cc.	Killed 28 days	No tuberculosis.
	3708	"	2·0 cc.	Killed 44 "	"
Mixed fluid from the hind-quarters	3705	Intrap.	2·5 cc.	Killed 28 "	"
	3706	"	2·5 cc.	Killed 44 "	"

Case 7.—HEIFER-CALF 1549.

Subcutaneous inoculation of culture derived from the mediastinal gland of Calf 1497 Virus H. 107. "H.H."

Dose—50·0 milligrammes.

Age at Inoculation—10 weeks.

Killed when in good health—97 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

(For full details see the Report on Lupus Viruses.)

Slight general tuberculosis, apparently progressive in thoracic glands.

There was a fibrous-walled cystic local tumour filled with caseo-pus and caseous masses; the adjacent prescapular gland was enlarged and caseous. The liver, spleen and lungs contained scattered calcareous or caseo-calcareous miliary tubercles, the kidneys a few grey tubercles. The lungs also showed on the surface in certain limited areas patches of fibro-calcareous tubercles, and a few scattered caseous gritty nodules.

In the right side of the heart about fifty grey nodules up to 6 mm. in diameter were counted, the majority with calcareous centres, and in the first few inches of the pulmonary artery several small fibrous tubercles were seen.

The thoracic glands were much enlarged and mainly occupied by caseous gritty tracts and patches of calcareous tubercles: the portal and one coeliac gland were similar.

In each suprarenal about a dozen grey nodules with caseo-calcareous centres were seen. Very numerous congested nodules each with a small central ulcer were seen in the small intestine and the Peyer's patches were thickened, ulcerated and beset with calcareous patches and foci.

The abdominal lymphatic glands not hitherto mentioned contained numerous calcareous tubercles, the mesenteric and ileo-colic glands being severely affected. An occasional tubercle was seen in the peripheral glands and in several haemo-lymph glands.

The mamma was well-developed; many of the milk ducts contained short plugs of purulent substance. No tubercles were seen in the organ.

Saline was injected into the mammary sinuses; the fluid recovered was milky, and deposited on standing yellow pus composed of the plugs from the ducts. The fluids from the two fore quarters were mixed together, as were also those from the hind quarters. A few tubercle bacilli were seen in smear preparations made from the mixed fluids. No guinea-pigs were inoculated.

Case 8. HEIFER-CALF 1577.

Subcutaneous inoculation of culture derived from the bronchial gland of Calf 1551 (2nd passage), Virus H. 107. "H.H."

Dose—50·0 milligrammes.

Age at inoculation—3½ months.

Killed when in good health—103 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

(For full details see the Report on Lupus Viruses.)

There was a fibrous-walled cyst with caseo-purulent contents at the seat of inoculation. The adjacent prescapular gland was extensively, and one prepectoral gland was entirely, caseous; two other adjacent glands contained each a calcareous nodule. Each suprarenal body showed one miliary tubercle. The thoracic glands contained a few minute caseous or calcareous

foci, and three abdominal glands contained one each.

The mamma, and supramammary glands, were normal.

Four cubic centimetres of saline solution were injected into each of the mammary sinuses and about 3·0 cc. of fluid (very slightly milky) were recovered in each case.

No tubercle bacilli were seen in the fluids on microscopical examination.

GUINEA-PIGS INOCULATED.

—		No. of Guinea-pig.	Mode of Inoculation.	Dose.	Duration of Life.	Result.
With the fluids recovered from—	The left fore quarter ...	3916	Intrap.	3·0 cc.	K. 60 days	No tuberculosis.
	The left hind quarter ...	3914	"	"	K. 60 "	No tuberculosis.
	The right fore quarter ...	3917	"	"	D. 28 "	No tuberculosis.
	The right hind quarter ...	3915	"	"	D. 16 "	No tuberculosis.

Case 9. HEIFER-CALF 1583.

Subcutaneous inoculation of culture derived from the mediastinal gland of Calf 1549 (1st passage).
Virus H. 107. "H.H."

Dose—50·0 milligrammes.

Age at inoculation—11 weeks.

Killed when in good health—127 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

(For full details see the Report on Lupus Viruses.)

There was a small cyst containing caseous masses and turbid fluid at the seat of inoculation, the adjacent prescapular gland contained caseous and caseo-calcareous nodules, and one cervical gland was beset with calcareous foci. One suprarenal body contained a minute calcareous focus. The thoracic and two or three abdominal lymphatic glands contained one or more calcareous foci, mostly minute.

The udder was small and showed very little glandular tissue; the supramammary glands were normal.

Four cubic centimetres of saline solution were injected into each of the mammary sinuses and about 3·0 cc. of fluid were recovered from each. No tubercle bacilli were seen in these four fluids on microscopical examination.

GUINEA-PIGS INOCULATED.

—		No. of Guinea-pig.	Mode of Inoculation.	Dose.	Duration of Life.	Result.
With the fluids recovered from—	The left fore quarter ...	3912	Intrap.	3·0 cc.	K. 56 days	No tuberculosis.
	The left hind quarter ...	3910	"	"	K. 56 "	No tuberculosis.
	The right fore quarter ...	3913	"	"	K. 56 "	No tuberculosis.
	The right hind quarter ..	3911	"	"	K. 56 "	No tuberculosis.

Case 10.—HEIFER-CALF 1533.

Subcutaneous inoculation of culture derived from the mediastinal gland of Calf 1417, Virus H. 108.
"H.R."

Dose—50·0 milligrammes.

Age at Inoculation—About 4 months.

Killed when in good health—98 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

(For full details see the Report on Lupus Viruses.)

Slight retrogressive generalised tuberculosis.

There was a large thin-walled cyst at the seat of inoculation containing caseo-pus and caseous masses; the adjacent prescapular gland was large and composed of caseous gritty substance. The lungs contained sixteen small nodules with caseo-calcareous centres, the spleen a moderate number of fibro-caseous gritty tubercles, the liver similar but less numerous tubercles, the right kidney two caseo-calcareous tubercles, the left a minute focus, the right suprarenal body two caseous gritty nodules, the left a caseous

tubercle. Nearly every Peyer's patch in the small intestine contained a few caseo-calcareous tubercles.

All the lymphatic glands in the body contained caseo-calcareous tubercles more or less numerous, in some cases confluent; several mesenteric and the ileo-colic glands were more than half caseo-calcareous. Every haemo-lymph gland examined contained a caseo-calcareous tubercle. The mamma was normal.

Some saline was injected into each of the mammary sinuses and small quantity of slightly turbid fluid recovered from each. No tubercle bacilli were seen in the mixed fluids from the fore quarters or in that from the hind quarters on microscopical examination.

GUINEA-PIGS INOCULATED.

—	No. of Guinea-pig.	Mode of Inoculation.	Dose.	Duration of Life.	Result.
Mixed fluids from the fore quarters of the mamma	3736	Intrap.	Small	Killed 72 days	Slight general tuberculosis.
Mixed fluids from the hind quarters of the mamma	3737	Intrap.	Small	Killed 72 „	No tuberculosis.

Case 11.—HEIFER 80.

Subcutaneous inoculation of an emulsion made from the original material (a mediastinal gland) of Virus B. V.

Dose—4,500,000 tubercle bacilli (Vol. 2·32 cc.).

Age at Inoculation—About 18 months.

Killed when in good health—62 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

(For full details see Vol. I of the Appendix to the 2nd Interim Report, page 198.)

Slight generalised tuberculosis.

The tumour at the seat of inoculation was mainly composed of dense caseating tissue; the adjacent glands were partly fibroid and contained caseous foci and patches. The lungs showed sparsely scattered congested nodules containing yellow foci up to a large pea in size. Caseous tubercles were scanty in the mediastinal and numerous in the bronchial glands.

There were three caseating tubercles in the spleen, and five greyish nodules each containing a minute caseous focus in the liver. One pancreatic gland contained a group of small yellow tubercles. There was no sign of tuberculosis elsewhere.

The uterus contained a 5 months old foetus. A guinea-pig inoculated with an emulsion of its spleen remained healthy.

The mammary sinuses contained a small quantity of thick yellowish turbid fluid; a smear preparation made from it showed no tubercle bacilli.

GUINEA-PIG INOCULATED.

—	No. of Guinea-pig.	Mode of Inoculation.	Duration of Life.	Result.
With a small quantity of the fluid from the mammary sinuses	816	Intrap.	Killed 88 days	General tuberculosis.

Case 12. HEIFER-CALF 1569.

Subcutaneous inoculation of culture derived from the original material of Virus H. 127. "R.R." (a) through Guinea-pig 3475.

Dose—50·0 milligrammes.

Age at inoculation—About 12 weeks.

Killed when in good health—105 days after inoculation.

ABSTRACT OF POST-MORTEM NOTES.

(For full details see the Report on Cases of Human Tuberculosis other than lupus.)

Slight general tuberculosis, apparently retrogressive.

There was an ulcerated fibro-calcareous tumour at the seat of inoculation and the adjacent glands were fibro caseo-calcareous or contained discrete tubercles.

The lungs showed a moderate number of tubercles up to 2 mm., the smaller grey the larger caseous and calcareous, and also a few consolidated lobules which were fibro-calcareous. The spleen contained a moderate number of miliary caseo-calcareous tubercles, the liver scattered calcareous tubercles.

The thoracic and abdominal glands contained scat-

tered calcareous tubercles and calcareous patches, the peripheral glands caseous gritty miliary tubercles.

The udder was well formed but not very large; it appeared normal. The supramammary glands were normal.

Thin grey purulent fluid was expressed from the teats of three of the quarters; the sinuses and ducts of the right hind quarter contained a large quantity but there was only a small quantity in each of the fore quarters; microscopical examination of these fluids showed a few tubercle bacilli in each case. From the left hind quarter no pus could be expressed and this quarter was washed out with salt solution; microscopical examination of the recovered fluid showed no tubercle bacilli.

Case 13.—GOAT 77 [Young Adult Female].

Subcutaneous inoculation of culture derived from the original material of Virus H. 118. "F.C." (sputum) through Guinea-pig 3343.

Dose—25·0 milligrammes.

Date of Inoculation—February 12, 1909.

Killed when in good health—June 8, 1909. [116 days after inoculation.]

Clinical Notes.

A large tumour developed at the seat of inoculation on the left side of the neck. On March 8, 24 days after inoculation it extended from the midde of the neck into the dewlap; it was soft and fluctuating, and the skin over it was thin and red. The adjacent prescapular gland was enlarged. Twelve days later the tumour burst and its contents were evacuated.

On April 5, 52 days after inoculation, the goat gave birth to two dead full-time foetuses; on post-mortem examination their organs and glands were found to be normal; a smear made from a portal gland in each case showed no tubercle bacilli.

Milk withdrawn from the udder by means of a catheter eight hours, one day, two days, 8, 14, 28 and 59 days after the birth of the kids, was inoculated into guinea-pigs.

The milk withdrawn from each half of the udder on April 5 (eight hours after parturition) was examined microscopically; it was thick and creamy-yellow in colour; no tubercle bacilli were seen. Centrifuged deposit from the milk was also microscopically examined with a negative result. Culture tubes were sown with the milk; no growth resulted.

Two days after the kids were born centrifuged deposits of milk from the right and the left halves of the udder were again examined microscopically; no tubercle bacilli were seen.

The goat remained in good health during the experiment.

Temperature.

The temperature was raised for a period of 19 days after the inoculation (maximum 40·5° C. on the 7th day); from the 19th to the 27th day it was irregular; subsequently it was normal, the range of variation during three months being only 1·0 C. (maximum 39·0°, minimum 38·0° C.).

Weights.

February 12, 1909	...	...	...	qrs.	lbs.
June 8, 1909	...	...	...	2	19
Loss of weight—10 lbs.				2	9

POST-MORTEM EXAMINATION.

The carcass was in good condition.

Local Lesion.—At the seat of inoculation there was a tumour measuring 6·5 by 4 by 2 cm. composed of caseous gritty nodules and masses set in fibrous tissue; the skin over it showed an ulcer 4·5 by 2 cm. in area with red granular floor showing dry haemorrhagic scabs and thickened inverted margins.

Left Prescapular Gland.—The left prescapular gland measured 4·5 by 2 by 1·5 cm. and showed in the cortex scattered caseo-calcareous nodules ranging from 2 to 7 mm. in diameter.

At the inferior extremity of the gland there were several discrete caseo-calcareous nodules in loose connective tissue.

Right Prescapular Gland.—The right prescapular gland measured 3·3 by 1·4 by 1 cm. and showed in the cortex a small group of about half a dozen caseo-calcareous tubercles.

Cervical Glands.—On the left side one of the lower cervical glands contained a pea-sized caseo-calcareous nodule and several small tubercles.

The rest were normal.

Lungs.—The lungs were crepitant and collapsed normally. They showed under the pleura sparsely scattered, evenly distributed, uniformly caseous gritty tubercles ranging from about 0·5 to rather more than 1 mm. in diameter. Here and there was a tubercle with a grey margin and caseo-calcareous centre.

There was no sign of disease elsewhere.

The mammary gland was normal.

GUINEA-PIGS INOCULATED WITH THE MILK OF GOAT 77.

(All the milk was drawn with a catheter.)

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
April 5, 1909 [52 days after inoculation; 8 hours after giving birth to two dead foetuses].	Left 115·0 cc.	3677	Intrap.	Left	10·0 cc.	D.	35 days	No tuberculosis. ? cause of death.
		3678	"	"	10·0 cc.	D.	30 "	No tuberculosis. Death probably from injuries.
	Right 170·0 cc.	3679	"	Right	10·0 cc.	K.	36 "	No tuberculosis.
		3680	"	"	10·0 cc.	D.	33 "	No tuberculosis. ? cause of death.
April 6, 1909 [53 days after inoculation; 1 day after parturition].	Left 140·0 cc.	3687	Intrap.	Left	10·0 cc.	K.	51 days	No tuberculosis.
		3688	"	"	10·0 cc.	K.	51 "	" "
	Right 220·0 cc.	3685	"	Right	10·0 cc.	K.	51 "	" "
		3686	"	"	10·0 cc.	K.	51 "	" "
April 7, 1909 [54 days after inoculation; 2 days after parturition].	Left 100·0 cc.	3695	Intrap.	Left	10·0 cc.	K.	56 days	No tuberculosis.
		3696	"	"	10·0 cc.	K.	56 "	" "
	Right 150·0 cc.	3693	"	Right	10·0 cc.	K.	56 "	" "
		3694	"	"	10·0 cc.	K.	56 "	" "

GUINEA-PIGS INOCULATED WITH THE MILK OF GOAT 77—*continued*.

Date.	Total yield of Milk in 24 hours.	No. of Guinea-pig.	Mode of Injection.	Half of Udder.	Dose of Milk.	Killed or Died.	Duration of Life.	Result.
April 13, 1909 [60 days after inoculation ; 8 days after parturition].	Left 160·0 cc.	3701	Intrap.	Left	10·0 cc.	K.	56 days	No tuberculosis.
		3702	"	"	10·0 cc.	K.	56 "	" "
	Right 220·0 cc.	3703	"	Right	10·0 cc.	K.	56 "	" "
		3704	"	"	10·0 cc.	K.	56 "	" "
April 19, 1909 [66 days after inoculation ; 14 days after parturition].	Left 229·0 cc.	3722	Intrap.	Left	9·0 cc.	K.	53 days	No tuberculosis.
		3723	"	"	10·0 cc.	K.	53 "	" "
	Right 280·0 cc.	3720	"	Right	10·0 cc.	K.	53 "	" "
		3721	"	"	10·0 cc.	K.	53 "	" "
May 3, 1909 [80 days after inoculation ; 28 days after parturition].	Left 240·0 cc.	3745	Intrap.	Left	10·0 cc.	K.	74 days	No tuberculosis.
		3746	"	"	10·0 cc.	K.	74 "	" "
	Right 300·0 cc.	3747	"	Right	10·0 cc.	K.	74 "	" "
		3748	"	"	10·0 cc.	K.	74 "	" "
June 3, 1909 [111 days after inoculation ; 59 days after parturition].	Left 190·0 cc.	3769	Intrap.	Left	10·0 cc.	K.	55 days	No tuberculosis.
		3770	"	"	10·0 cc.	K.	55 "	" "
	Right 230·0 cc.	3767	"	Right	10·0 cc.	K.	55 "	" "
		3768	"	"	10·0 cc.	K.	55 "	" "

INVESTIGATION OF TUBERCLE BACILLI FROM CASES
OF SWINE TUBERCULOSIS

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INVESTIGATION OF TUBERCLE BACILLI FROM CASES OF SWINE TUBERCULOSIS.

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INTRODUCTION.

THIS report gives the results of the inquiry into the nature of the tubercle bacilli concerned in the production of tuberculosis in swine, and is based upon the investigation of material from 63 cases of natural tuberculosis. The material used was taken from swine which had been found to be tuberculous at the slaughterhouse, the extent to which these animals were diseased ranging from tuberculosis seemingly limited to certain lymphatic glands to tuberculosis generalised throughout the body. Out of the total number of swine slaughtered at the Metropolitan Meat Market during the period from March, 1905, to October, 1906, those showing apparently localised tuberculosis were specially sought for to furnish material for investigation. In addition material was obtained from cases of general tuberculosis of all degrees of severity, and the cultures obtained were isolated sometimes from the submaxillary glands, sometimes from metastatic lesions.

The cases which were considered to have been localised include all those in which the examination ordinarily adopted at the slaughterhouse revealed no obvious tuberculosis elsewhere. But there must be remembered the possibility of early lesions having been overlooked, and indeed it is difficult to believe that such extensive local tuberculosis as was found in Viruses XXXIII., XXXVI., LI., and LII., could exist in young animals such as these without any dissemination having occurred. In 21 out of the 63 swine from which tuberculous material was obtained the disease was stated to be localised; in nine no details were given as to the condition of the rest of the body; the remaining 33 showed generalised tuberculosis varying in severity.

This series shows clearly that natural tuberculosis in swine arises by infection from the alimentary tract, and that the disease when localised is usually limited to the glands situated near the angle of the jaw. These, the submaxillary glands, have been most often used as the source of cultures both because the disease was sometimes limited to them and also because they were the glands nearest the site of entry of the tubercle bacilli to the alimentary tract. Cultures were obtained altogether from 59 of the cases; the sources from which they were isolated are as follows:—Submaxillary glands (44), bronchial glands (4), spleen (2), mesenteric glands (2), submaxillary and bronchial gland (1), skin, bone, joint, lung, udder, and inguinal gland (each 1). From the remaining four viruses cultures were not obtained, nor did the animals inoculated with the original material develop tuberculosis.

In certain instances, when several animals in a single herd have been tuberculous, specimens have been taken from one or two individuals only.

METHOD OF INVESTIGATION.

The specimens on arrival were carefully examined and the tuberculous lesions which appeared most suitable for experimental purposes were selected. From this material emulsions for cultures and animal inoculations were made in the usual way; the surface of each part selected was seared with a Paquelin's cautery and pieces were removed with sterile instruments and emulsified with salt solution, the procedures being the same as those described in a previous report (Appendix to 2nd Interim Report, Vol. III, page 3). In all cases cultures were sown direct from the original material, and guinea-pigs were almost invariably and rabbits occasionally inoculated with emulsions of the fresh material.

The pathogenic effects of the various viruses have been investigated by the inoculation of culture obtained in all but four instances direct from the original material; the inoculations of guinea-pigs and rabbits with emulsions of the original material were made with the object of obtaining a culture from them should the direct culture fail, as well as to afford some preliminary indication of the virulence of the bacillus. The virulence of the cultures of all the viruses has been tested on rabbits and guinea-pigs and cultures of fifteen viruses have also been inoculated into calves. Rabbits have been systematically employed in place of calves for testing the pathogenic properties of the cultures since it has been established in previous investigations that, when a virus shows full virulence for rabbits by the various methods of inoculation, it will be capable also of setting up progressive tuberculosis in the calf.

CONSIDERATION OF RESULTS.

In this investigation a study has been made of the cultural characters and virulence of tubercle bacilli obtained from 59 cases of tuberculosis occurring naturally in swine.

The bacilli isolated from these cases have manifested wide variations in the character of their growth on artificial media and in their virulence for animals, and can be divided into three groups clearly distinguished from each other.

The group from which bovine tubercle bacilli were isolated.

In this group, by far the largest of the three, are included 50 out of the total number of swine viruses investigated. The cultures isolated correspond exactly with those obtained from cases of natural tuberculosis in the ox. They vary in capacity for growth on artificial media within the same limits as the bovine tubercle bacillus and exhibit the same high degree of virulence when inoculated into calves, rabbits, and guinea-pigs.

All the 50 cultures have been inoculated into rabbits (intravenously, intraperitoneally, and subcutaneously), and guinea-pigs (intraperitoneally and subcutaneously), and have produced in these animals without exception fatal general tuberculosis.

In addition seven have been inoculated subcutaneously into calves in doses of 50 milligrammes, and, with one exception, have caused severe and fatal tuberculosis within 48 days identical in all its features with that set up by bovine tubercle bacilli.

The exceptional result occurred with the culture derived from Virus P. XIV. (*see* table, pages 240-241), which gave rise in four calves to general tuberculosis, much less severe than that ordinarily produced by 50 milligrammes of bovine tubercle bacilli. A culture isolated from one of these calves was inoculated into two more calves, each in a dose of 50 milligrammes, and caused fatal general tuberculosis within the usual period. Apparently the culture from the original material, which was slightly though definitely less virulent than any bovine tubercle bacillus, became possessed of the full virulence of a bovine tubercle bacillus after a single passage through a calf.

The group from which human tubercle bacilli were isolated.

This group contains three viruses, P. IV., P. XLI., and P. XLVI., obtained from swine in which the disease was localised in the submaxillary glands. The cultures of these viruses grow much more luxuriantly on media containing glycerin than any of those in the preceding group and resemble closely the more easy growing cultures of human origin. They have a correspondingly low degree of virulence for the calf and rabbit, though one, Virus P. IV., appears to be slightly more virulent than the other two.

Virus P. XLI. and Virus P. XLVI. were inoculated subcutaneously each into two calves, the doses being 100 milligrammes and 50 milligrammes in one case, and 75 milligrammes and 50 milligrammes in the other. The calves were killed in from 98 to 105 days and each showed a local lesion and slight tuberculosis of the nearest glands only. A series of rabbits was inoculated with culture from each of the two viruses, intravenously, intraperitoneally and subcutaneously (pages 191-195): a few of the rabbits died prematurely, the rest increased in weight and when killed after periods varying from 99-174 days were found to have slight and non-progressive tuberculous lesions.

The culture of Virus P. IV. was inoculated subcutaneously into two calves in doses of 50 milligrammes and 34 milligrammes. The former, Calf 312, killed after a period of 90 days, showed a small fibrocaseous local lesion with caseation of the prescapular gland, tuberculous broncho-pneumonia of the dorsal parts of the caudal

lobes of the lungs and several tubercles in the suprarenal bodies and in a few of the lymphatic glands. In the second calf, Calf 314, killed after 135 days, there was a cystic local lesion and caseation of the nearest glands, a tubercle in a mediastinal gland, and a few gritty foci in the mesenteric glands without any disease elsewhere. A third calf, Calf 350, was inoculated with the culture after it had been a longer period in cultivation (total period 183 days) in a dose of 50 milligrammes subcutaneously, and when killed after 90 days showed a cystic local tumour, caseation of the nearest glands and a few foci in the mediastinal and mesenteric glands without any disease elsewhere.

The culture from the original material of Virus P. IV. was also inoculated into a series of rabbits intravenously, intraperitoneally and subcutaneously (pages 191-195): one rabbit, inoculated intraperitoneally with a dose of 10 milligrammes died in 18 days of tuberculosis; another died of chronic general tuberculosis in 333 days after an intraperitoneal inoculation of 1.0 milligramme; the rest were killed after a period of about 90 days, and showed generalised tuberculosis rather more severe than that usually produced by a slightly virulent virus of human origin.

The virulence of these three viruses was tested also on the pig.

Two pigs, one, Pig 166, inoculated subcutaneously, the other, Pig 172, fed, each with 50 milligrammes of culture of Virus P. XLI. were killed after 102 and 98 days respectively: the animal that was fed showed only slight apparently retrogressive tuberculosis; the inoculated animal, Pig 166, had, in addition to local disease, a severe tuberculous broncho-pneumonic condition of the lungs with very little disease elsewhere.

From the lung of Pig 166 a culture was isolated directly and used to inoculate rabbits and a second pig, No. 202. Pig 202 received 50 milligrammes subcutaneously, and died after 64 days of tuberculous consolidation of the lungs, the condition being very similar to that in the first pig.

From the lung of Pig 202 an emulsion and a culture were made. The emulsion was inoculated subcutaneously into Pig 228, which was killed when well after 166 days, and showed slight non-progressive tuberculosis; the culture was inoculated into rabbits and into a third pig, No. 258.

Pig 258 was inoculated subcutaneously with 50 milligrammes of the culture, and died of tuberculous broncho-pneumonia in 103 days; from the lung a culture was isolated which was inoculated into rabbits.

This final culture, as well as the intermediate cultures, had only slight virulence for rabbits, and grew in the same luxuriant manner as the original culture.

This virus therefore exhibited higher virulence for the pig, though not for other animals, than the human tubercle bacillus, a virulence which was not increased by passage through the body of the pig.

The other two viruses (P. XLVI. and P. IV.) displayed no higher virulence for the pig than the human tubercle bacillus.

Two pigs, Pig 164 inoculated subcutaneously, Pig 168 fed, each with 50 milligrammes of Virus P. XLVI. were killed after 97 and 60 days respectively, and showed only slight retrogressive tuberculosis.

The virulence of Virus P. IV. was tested on four pigs; one was inoculated and one fed with culture from the original material, and one inoculated and one fed with culture from Calf 312, the dose in each case being 1 milligramme. All were killed after about four months and showed slight retrogressive tuberculosis.

Cultures from each of the three viruses in this group have also been inoculated into guinea-pigs (subcutaneously and intraperitoneally) and into fowls (Virus P. IV. by feeding, Viruses P. XLI. and P. XLVI. intravenously). All the guinea-pigs developed fatal general tuberculosis: the fowls remained well and when killed were free from tuberculosis.

The group from which avian tubercle bacilli were isolated.

The five viruses, P. II., P. III., P. XXI., P. XXVII., and P. XLIV., included in this group were, like those in the preceding group, obtained from swine in which the disease was seemingly limited to the submaxillary glands.

Cultures, isolated in each case directly from the glands, exhibit marked differences from those in the first two groups and possess all the properties of the avian tubercle bacillus.

The cultures have been compared, as regards their virulence for animals and manner of growth on artificial media, with cultures of avian tubercle bacilli isolated from birds with natural tuberculosis and found to be identical.

The experiments with the different strains of avian tubercle bacilli are fully considered in a separate report. See Vol. IV. of this Appendix.

Mixed Virus.

In the case of Virus P. XLII. the culture isolated from a pig's submaxillary gland was at first considered to be a pure culture of the bovine tubercle bacillus; a fourth subculture on glycerin agar showed, however, besides dry warty colonies a few shiny translucent colonies; by repeated subculture and incubation at 42° C. a pure culture of the avian tubercle bacillus was separated.

The original culture caused fatal tuberculosis in rabbits and guinea-pigs identical with that produced by the bovine tubercle bacillus.

The avian culture was inoculated into two fowls and two guinea-pigs. Both fowls, one inoculated intraperitoneally, the other subcutaneously, died of general tuberculosis identical with that produced by cultures of avian tubercle bacilli derived from birds. One guinea-pig, No. 2489, inoculated subcutaneously with 200 milligrammes, showed merely a scar at the seat of inoculation when killed after 114 days; the second, No. 2490, inoculated intraperitoneally with 1.0 milligramme, died in 80 days, and showed at the post-mortem examination softening of the sternal and portal glands and grey foci in the liver and kidneys; the culture isolated from the sternal gland was typically avian.

VIRUSES FROM WHICH CULTURES WERE NOT OBTAINED.

Included under this head are Viruses P. XLVIII., XXVIII., XXXV., and XLV.

Virus P. XLVIII. was one of two received on the same day and obtained from a herd of swine, several of which had tuberculosis; a rabbit inoculated intraperitoneally with an emulsion of the original material developed progressive general tuberculosis, but cultures were not obtained.

Virus P. XXVIII. was obtained from an old sow which had enlarged calcareous submaxillary glands with no sign of tuberculosis elsewhere; although tubercle bacilli were fairly numerous direct cultures failed, and none of the animals (two rabbits and a guinea-pig) inoculated with an emulsion of the original material developed tuberculosis.

Cultures from Virus P. XXXV. also failed, nor did any of the animals (a rabbit and a guinea-pig) inoculated develop tuberculosis, although tubercle bacilli were fairly numerous in smear preparations from the original material.

Cultures from Virus P. XLV. failed through all the tubes becoming contaminated; the rabbit inoculated from the original material died in 10 days from psorospermiosis.

SUMMARY.

The material used in the investigation has been obtained from 63 cases of tuberculosis occurring naturally in swine; in 21 of these the disease was apparently localised to the lymphatic glands (submaxillary and mesenteric) of the alimentary tract from which the material used for investigation was taken; in 33 the disease was generalised; in the remaining nine the condition of the rest of the body could not be ascertained with certainty.

In every animal in the series with two exceptions the disease appeared to be alimentary in origin. In these two cases, P. VI. and P. XVI., the condition of the glands in connection with the alimentary tract had not been ascertained.

Cultures have been isolated from 59 out of the 63 cases, either directly from the original material or through the guinea-pig; the source of the culture was, in the majority of instances, the submaxillary glands (44), but cultures have been isolated from various metastatic lesions (15). From the remaining four cases cultures were not obtained.

The cultures from the 59 cases can be divided according to their cultural characters and virulence into three groups; in the first group there are 50 cultures which are identical with bovine tubercle bacilli with the exception of one, Virus P. XIV., which is definitely less virulent for calves and rabbits than any bacillus derived from a bovine source; the second group contains three, Viruses P. IV., P. XLI., and P. XLVI., which correspond to the slightly virulent tubercle bacillus of human origin (the human tubercle bacillus); in the third group there are five, Viruses P. II., P. III., P. XXI., P. XXVII., and P. XLIV., which exhibit all the characters of the avian tubercle bacillus.

From the remaining culture, Virus P. XLII., which was found to be a mixture, pure cultures of bovine and avian tubercle bacilli have been separated.

These figures cannot be taken as representing the relative frequency with which in nature swine tuberculosis is caused by the three types of tubercle bacilli mentioned, since, as stated in the introduction, some amount of selection was exercised in obtaining material.

A consideration of the extent of the disease in relation to the type of bacillus isolated shows that in none of the swine from which either human tubercle bacilli or avian tubercle bacilli in pure culture were obtained was there evidence of generalised tuberculosis, the disease in every instance being localised in the submaxillary glands.

When the tuberculosis is slight in extent and limited to the submaxillary glands, it is impossible from the appearance of the lesions alone to decide what particular type of bacillus produced it. This will be seen from a comparison of the descriptions of the original material of the viruses from which the avian and human tubercle bacilli were isolated with those of Viruses P. XXXVIII., P. XXXIX., P. XLIII., and P. XLVII., from which bovine tubercle bacilli were obtained.

Out of the total number of 50 swine from which bovine tubercle bacilli were isolated, 32 showed generalised tuberculosis, in 9 the tuberculosis was regarded as localised, and in 9 no details as to the condition of the rest of the carcasses could be obtained.

CONCLUSIONS.

1. Natural tuberculosis in swine may be the result of infection either with the bovine tubercle bacillus, the human tubercle bacillus, or the avian tubercle bacillus.
2. The bovine tubercle bacillus is the most common cause of tuberculosis in swine and has been found in every case in this series where there was disseminated tuberculosis, as well as in more than half (10 out of 18) of those in which, so far as could be ascertained, the disease was localised.
3. The tuberculous lesions in the pig's lymphatic glands caused by the human tubercle bacillus or the avian tubercle bacillus cannot be distinguished from the lesions sometimes produced by the bovine tubercle bacillus.

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TABLE OF ORIGINS OF PORCINE VIRUSES.

VIRUSES OF PORCINE ORIGIN.

Designation of Virus.	Source.	Date of Receipt of Virus.	Description of Animal and Lesions.	Tissue used for Experiment.	Animals Inoculated.	Classification of Virus according to Cultural Characters and Virulence.
P. I.	Metropolitan Cattle Market.	March 3, 1905	The material received was from a sow about twelve months old. It consisted of the right submaxillary glands, which were severely affected, and of inguinal glands showing one nodule. It was stated that the lungs were also slightly affected. One submaxillary gland (from which the cultures were made) was enlarged and composed throughout of calcareo-caseous substance. The other submaxillary glands contained large calcareo-caseous nodules.	Submaxillary Gland.	Rabbits and Guinea-pigs only.	Bovine.
P. II.	Metropolitan Cattle Market.	March 9, 1905	The material was obtained from a young pig about six months old reported to have shown no sign of disease elsewhere. The specimens received were two submaxillary glands not apparently enlarged but showing on section fine caseous streaks and foci. A smear from one of the glands showed moderate numbers of tubercle bacilli.	Submaxillary Gland.	1 Calf, 4 Pigs, 2 Goats, 4 Monkeys, 2 Cats, Fowls, Rabbits, Guinea-pigs, and Rats.	Avian.
P. III.	Metropolitan Cattle Market.	March 10, 1905	Submaxillary glands from a pig about six months old reported to have shown no sign of disease elsewhere. These glands showed on section coarse streaks of caseation in the centre of which signs of early calcification were observed. A few tubercle bacilli were found in a smear from one of the glands.	Submaxillary Gland.	2 Calves, 1 Pig, 1 Monkey, 4 Cats, 1 Dog, Fowls, Rabbits, Guinea-pigs, and Rats.	Avian.
P. IV.	Metropolitan Cattle Market.	March 21, 1905	The specimens received were the submaxillary glands from a pig about seven months old which was reported to have shown no sign of tuberculosis elsewhere. The glands, not enlarged, contained isolated discrete caseo-calcareous tubercles embedded in normal gland tissue.	Submaxillary Gland.	6 Calves, 4 Pigs, 1 Cat, 1 Dog, 1 Fowl, Rabbits, Guinea-pigs, and Rats.	Human (Group II).
P. V.	Metropolitan Cattle Market.	April 18, 1905	Specimens received were the submaxillary and bronchial glands from a sow. It was stated that the inguinal glands were tuberculous, the lungs pneumonic, and the joints enlarged. The submaxillary glands contained gritty cheesy nodules; a bronchial gland a single nodule of similar character.	Submaxillary Gland and Bronchial Gland.	1 Calf, Rabbits, Rats, Guinea-pigs.	Bovine.

P. VI.	Metropolitan Cattle Market.	April 28, 1905	Udder and inguinal glands of an old sow with tuberculosis of the lungs. The piece of udder and the glands contained firm yellow caseous nodules, slightly gritty from calcification.	Inguinal Gland.	1 Calf, Rabbits, Guinea-pigs.	Bovine.
P. VII.	Metropolitan Cattle Market.	April 28, 1905	A tuberculous submaxillary gland of a young sow the subject of general tuberculosis. The submaxillary gland submitted for investigation was very large; on section it was composed throughout of caseo-necrotic tissue softened and broken down chiefly around the periphery, and surrounded by a fibrous wall.	Submaxillary Gland.	Rabbits and Guinea- pigs only.	Bovine.
P. VIII.	Metropolitan Cattle Market.	May 11, 1905	The specimens received were from a young pig, fat and in good condition. Two submaxillary glands, one the size of a Tangerine orange, the other half that size, were indurated, and showed on section firm grey translucent caseating tissue. The lungs were beset with discrete nodules, ranging in size from a pin's head to that of a small pea; these were greyish red at the margins, caseous in the centre. Mesenteric glands normal.	Submaxillary Gland.	1 Calf, Rabbits, Guinea-pigs.	Bovine.
P. IX.	Metropolitan Cattle Market.	May 18, 1905	The specimens received were the submaxillary and sublumbar glands from a young sow. The submaxillary glands were enlarged and fibroid, showed on section firm masses and irregular streaks of caseation distinctly gritty from calcification. The lumbar glands contained caseous tubercles. The lungs were affected. A few tubercle bacilli were found in a smear from one of the submaxillary glands.	Submaxillary Gland.	1 Calf, Rabbits, Guinea-pigs.	Bovine.
P. X.	Metropolitan Cattle Market.	May 18, 1905	The specimens received were mesenteric glands, lung and udder, from an old sow. The mesenteric glands contained softened caseous tubercles, very slightly gritty from calcification; in some of the glands the tubercles were discrete; in others confluent. The piece of lung showed softened caseous nodules, the largest the size of a pea; these were also very slightly gritty. The udder was normal. No tubercle bacilli were seen in an emulsion made from a mesenteric gland.	Mesenteric Gland.	Rabbits and Guinea- pigs only.	Bovine.
P. XI.	Metropolitan Cattle Market.	June 1 1905	The material received was from a young pig affected with general tuberculosis. The submaxillary glands were enlarged, caseous practically throughout and beginning to soften. The mesenteric glands were normal. The lungs contained sparsely scattered miliary caseous tubercles; the liver a few small tubercles, some caseous; the spleen about 8 nodules ranging from 2 to 10 mm. in diameter, caseous in the centre.	Submaxillary Gland.	1 Calf, Rabbits, Guinea-pigs.	Bovine.

VIRUSES OF PORCINE ORIGIN—*continued*.

Designation of Virus.	Source.	Date of Receipt of Virus.	Description of Animal and Lesions.	Tissue used for Experiment.	Animals Inoculated.	Classification of Virus according to Cultural Characters and Virulence.
P. XII.	Metropolitan Cattle Market.	June 26, 1905	The specimen received was a submaxillary gland of a young pig. The gland was enlarged, caseous and softened almost throughout; the caseous material contained gritty particles. Moderate numbers of tubercle bacilli were found in a smear from the gland. There was no statement as to absence of disease elsewhere.	Submaxillary Gland.	3 Calves, Rabbits, Fowls, and Guinea-pigs.	Bovine.
P. XIII.	Metropolitan Cattle Market.	July 6, 1905	The specimens received were the submaxillary and bronchial glands of a young pig, the lungs of which were reported to be slightly affected. The submaxillary glands were enlarged, caseating throughout and very gritty from calcification; one of the glands was partly broken down, containing thick greenish-pus. The bronchial glands were enlarged and closely beset with irregular caseo-calcareous tubercles.	Submaxillary Gland.	Rabbits and Guinea-pigs only.	Bovine.
P. XIV.	Metropolitan Cattle Market.	July 13, 1905	The specimens received were submaxillary and inguinal glands and portions of lung of a young pig. Two submaxillary glands were closely beset with slightly gritty caseous foci; two inguinal glands contained each a small softened caseous nodule. The lung contained numerous nodules ranging in size from a pin's head to a small pea; the nodules were soft caseous and slightly gritty and had thin fibrous capsules.	Submaxillary Gland.	6 Calves, Rabbits, Guinea-pigs, Fowl, and Rats.	Bovine.
P. XV.	Metropolitan Cattle Market.	August 1, 1905	The specimens received were two submaxillary and two inguinal glands and part of the spleen of a young sow. The lungs of this animal were reported as not affected, but the right shoulder was enlarged and regarded as tuberculous. One of the submaxillary glands the size of a pigeon's egg was caseo-calcareous throughout and softened in the centre; the other showed caseous streaks and points in a firm translucent tissue. The inguinal glands each contained small caseous nodules. In the spleen there were numerous nodules varying in size from a pin's head to that of a pea, translucent, with caseous centres.	Submaxillary Gland.	Rabbits, Guinea-pigs, and Rats.	Bovine.

P. XVI.	Metropolitan Cattle Market.	August 14, 1905	The specimens received were three bronchial glands and a piece of the lung of a pig. The glands were apparently enlarged and contained a few gritty caseous nodules; the piece of lung was not affected.	Bronchial Gland	Rabbits and Guinea-pigs only.	Bovine.
P. XVII.	Metropolitan Cattle Market.	August 14, 1905	The specimens received were the lungs, bronchial glands and two mesenteric glands of a pig. The lungs and bronchial glands were not affected. One mesenteric gland was caseo-calcareous throughout; the other was partly caseo-calcareous; both glands were beginning to soften.	Mesenteric Gland	Rabbits and Guinea-pigs only.	Bovine.
P. XVIII.	Metropolitan Cattle Market.	August 14, 1905	The specimens received were two mesenteric glands, a piece of lung and the bronchial glands of a pig. The mesenteric glands contained sparsely scattered yellow gritty foci. The piece of lung was quite solid; about half was yellow, caseous and softened; the rest was composed of firm grey tissue with pea-sized nodules embedded in it. One bronchial gland contained numerous yellow caseous foci; another contained a yellow gritty nodule, 2 mm. in diameter; two others were normal.	Lung	Rabbits and Guinea-pigs only.	Bovine.
P. XIX.	Metropolitan Cattle Market.	August 14, 1905	Two small tuberculous submaxillary glands of a pig were received. They contained a few yellow caseous gritty foci. No details as to the condition of the rest of the body were given.	Submaxillary Gland.	Rabbits, Guinea-pigs, and Rats.	Bovine.
P. XX.	Metropolitan Cattle Market.	November 30, 1905	The specimens received were the submaxillary and inguinal glands of a sow about 14 months old. Two submaxillary glands, each the size of a pheasant's egg, were composed throughout of gritty caseous material beginning to soften; some other glands were partly caseous or contained hard caseous nodules. The inguinal glands contained two small caseous tubercles.	Submaxillary Gland.	Rabbits and Guinea-pigs only.	Bovine.

VIRUSES OF PORCINE ORIGIN—continued.

Designation of Virus.	Source.	Date of Receipt of Virus.	Description of Animal and Lesions.	Tissue used for Experiment.	Animals Inoculated.	Classification of Virus according to Cultural Characters and Virulence.
P. XXI.	Metropolitan Cattle Market.	December 4, 1905	The specimens received were the submaxillary, inguinal and mesenteric glands, and the lung from a young boar condemned for pleurisy. The submaxillary gland was perhaps slightly enlarged and contained discrete caseous milary tubercles, slightly gritty from calcification. Collected together in one place into a nodule the size of a pea; the tubercles readily shelled out from the surrounding gland tissue which was normal in appearance. Numerous tubercle bacilli were seen in an emulsion made from the submaxillary gland. The inguinal and mesenteric glands and the lung showed no sign of tuberculosis.	Submaxillary Gland.	1 Calf, 1 Dog, 3 Monkeys, Fowls, Rabbits, Guinea-pigs, and Rats.	Avian.
P. XXII.	Metropolitan Cattle Market.	September 29, 1905	The pig which furnished the specimens was about seven months old, and was in good condition. The submaxillary glands were greatly enlarged and consisted throughout of dense caseating tissue appreciably gritty from calcification. No tubercle bacilli were seen in a smear from one of these glands. A dorsal mediastinal gland, the size of a pigeon's egg, was in a similar condition but was perhaps more gritty. The lung contained fairly numerous yellow calcareous milary tubercles.	Submaxillary Gland.	Rabbits and Guinea-pigs.	Bovine.
P. XXIII.	Metropolitan Cattle Market.	September 27, 1905	The specimens received were the submaxillary and bronchial glands and a portion of the lung of a pig about 7 months old, in good condition. Two submaxillary glands showed on section calcarco-caseous streaks. The bronchial glands were moderately enlarged, very dense, and closely infiltrated with irregular calcarco-caseous streaks. No tubercle bacilli were seen in a smear from one of the bronchial glands. The piece of lung contained several large nodules, up to the size of a marble, with grey margins and soft caseous centres; there were also several smaller nodules with opaque caseous centres.	Bronchial Gland.	Rabbits and Guinea-pigs only.	Bovine.
P. XXIV.	Metropolitan Cattle Market.	December 8, 1905	The material received was from a young boar, the carcass of which was in good condition and was condemned. The submaxillary glands were enlarged and beset with caseous slightly gritty tubercles, in many places aggregated together to form large nodules with a mulberry-like outline; the tubercles could be readily shelled out from the surrounding gland tissue. A few tubercle bacilli were seen in a smear made from one of the glands. The bronchial and mesenteric glands contained scattered discrete caseous tubercles. The inguinal glands, lung, liver and spleen were normal.	Submaxillary Gland.	Rabbits and Guinea-pigs only.	Bovine.

P. XXV.	Metropolitan Cattle Market.	December 8, 1905	<p>The specimens, the submaxillary and inguinal glands, were from the carcass of a young pig about 8 months old.</p> <p>The submaxillary glands were much enlarged, indurated, smooth and rounded externally; on section they were composed of translucent gland-like tissue containing necrotic patches and an irregular necrotic network; the patches had a greyish-white translucent appearance and showed in the centre opaque white streaks (?) of beginning calcification. Moderate numbers of tubercle bacilli were seen in a smear from one of the glands. The inguinal glands were normal.</p>	Submaxillary Gland.	Rabbits and Guinea- pigs only.	Bovine.
P. XXVI.	Metropolitan Cattle Market.	December 8, 1905	<p>The specimens received were two enlarged submaxillary glands and inguinal glands. One submaxillary gland was caseous and softened throughout and surrounded by a thick fibrous capsule; the other was firm and showed a softened caseous gritty mass and numerous discrete milky caseous tubercles. Two tubercle bacilli were seen in a smear from one of the glands. The inguinal glands were normal.</p>	Submaxillary Gland.	Rabbits and Guinea- pigs only.	Bovine.
P. XXVII.	Metropolitan Cattle Market.	December 11, 1905	<p>The specimens received were the submaxillary glands from a pig the carcass of which had been condemned for pleurisy. It was stated that there was no sign of tuberculosis in any part of the body with the exception of the submaxillary glands.</p> <p>These glands showed on section opaque whitish irregular slightly gritty caseous tubercles, mostly discrete, but here and there collected together into small groups. Numerous tubercle bacilli were seen in a smear from one of the glands.</p>	Submaxillary Gland.	2 Calves, 1 Pig, 1 Monkey, Fowls, Rabbits, and Guinea- pigs.	Avian.
P. XXVIII.	Metropolitan Cattle Market.	December 20, 1905	<p>Submaxillary glands from a fat sow, about two years old, killed on December 19th, 1905.</p> <p>The glands, five in number, each about the size of a thrush's egg, were stony hard and nodular on the surface; on section they were composed of dry, mortar-like calcareo-caseous material surrounded by a thin capsule of fibrous tissue. It was stated that there was no sign of disease in any other part of the body. A few tubercle bacilli were seen in an emulsion made from one of the glands.</p>	Submaxillary Gland.	Rabbits and Guinea- pigs.	No culture isolated.
P. XXIX.	Metropolitan Cattle Market.	December 20, 1905	<p>The material received, a submaxillary gland, was from a young pig reported as the subject of general tuberculosis.</p> <p>The gland was greatly enlarged, indurated, and showed on section a coarse caseous network, slightly gritty from calcification; the tissue in the interstices of the network was grey and translucent. A smear from the gland showed fairly numerous tubercle bacilli.</p>	Submaxillary Gland.	1 Calf, Rabbits, and Guinea-pigs.	Bovine.

VIRUSES OF PORCINE ORIGIN—continued.

Designation of Virus.	Source.	Date of Receipt of Virus.	Description of Animal and Lesions.	Tissue used for Experiment.	Animals Inoculated.	Classification of Virus according to Cultural Characters and Virulence.
P. XXX.	Metropolitan Cattle Market.	December 20, 1905	The specimens received were two submaxillary glands of a young pig reported as the subject of general tuberculosis. These glands were moderately enlarged and showed the substance irregularly caseated; there was no calcification. A smear from one of the glands showed fairly numerous tubercle bacilli.	Submaxillary Gland.	Rabbits and Guinea-pigs.	Bovine.
P. XXXI.	Metropolitan Cattle Market.	December 20, 1905	The material, a submaxillary gland, was from a young pig reported as the subject of general tuberculosis. The gland was very large, hard, and showed on section practically the whole of its substance composed of dense, waxy, translucent tissue, penetrated with fine whitish streaks of calcification. In a smear from the gland fairly numerous tubercle bacilli were found.	Submaxillary Gland.	Rabbits and Guinea-pigs.	Bovine.
P. XXXII.	Metropolitan Cattle Market.	February 12, 1906	The specimens received were the submaxillary glands from a pig about six months old, the carcass of which was condemned. One of the glands was the size of a pheasant's egg and was caseous and softened throughout; the other glands were smaller and showed varying amounts of caseation; the caseated tissue in the latter glands was firm, gritty and not softened.	Submaxillary Gland.	Rabbits and Guinea-pigs.	Bovine.
P. XXXIII.	Metropolitan Cattle Market.	February 15, 1906	The specimens received were the submaxillary glands of a young pig six months old. It was stated that there was no tuberculosis elsewhere in this animal. A gland from one side of the neck, the size of a pheasant's egg, was caseo-necrotic throughout and beginning to soften. A smaller gland showed discrete tubercles. The lesions were just perceptibly gritty. A smear from one of the glands showed very few tubercle bacilli. The glands on the opposite side were normal.	Submaxillary Gland.	Rabbits and Guinea-pigs.	Bovine.
P. XXXIV.	Metropolitan Cattle Market.	February 17, 1906	The specimens received were the submaxillary glands and lung of a pig six months old. One submaxillary gland was enlarged, caseous and softened throughout, and slightly gritty; another smaller gland was partly caseous. Very few tubercle bacilli were found in a smear from one of the glands. The lung contained scattered softened caseous nodules up to 2 mm. with translucent grey margins.	Submaxillary Gland.	Rabbits and Guinea-pigs.	Bovine.

P. XXXV.	Metropolitan Cattle Market.	March 9, 1906	The specimens received were submaxillary glands from a pig about six months old. It was stated that there was no sign of tuberculosis elsewhere in the body. These glands were a little enlarged and firmer than normal, and showed on section irregular yellow necrotic streaks, some coarse, others fine. There was no calcification. A smear from one of the glands showed tubercle bacilli in moderate numbers.	Submaxillary Gland.	Rabbit and Guinea- pig.	No culture isolated.
P. XXXVI.	Metropolitan Cattle Market.	March 24, 1906	The specimens received were the submaxillary glands and portion of lung of a pig about ten months old. It was stated that there was no tuberculosis elsewhere in this animal. The submaxillary glands were fused together forming a mass nearly the size of a goose's egg. On section they were composed throughout of friable caseo-necrotic tissue, slightly gritty from calcification. The piece of lung was almost entirely consolidated, and was pinkish and translucent; no tubercles were seen in it.	Submaxillary Gland.	Rabbits and Guinea- pigs.	Bovine.
P. XXXVII.	Metropolitan Cattle Market.	March 24, 1906	The specimens received were the submaxillary glands, a bronchial gland and portion of lung from a pig about ten months old. The submaxillary glands were fused together (capsules adherent) forming a large firm mass the size of a goose's egg; on section they were composed throughout of pinkish necrotic tissue with white calcareous lines; the capsules were greatly thickened. The piece of lung was solid and pinkish grey; no tuberculous nodules seen in it. The bronchial gland showed small patches of early caseation.	Submaxillary Gland.	Rabbits and Guinea- pigs.	Bovine.
P. XXXVIII.	Metropolitan Cattle Market.	May 15, 1906	The specimens received were submaxillary glands, one from each side of the neck, of a young pig. It was stated that there was no tuberculosis elsewhere. In the centre of one gland there was a pea-sized caseous nodule, the rest of the gland containing scattered minute yellowish foci. A few tubercle bacilli were found in a smear made from it. The other gland was small and was not affected.	Submaxillary Gland.	Rabbits and Guinea- pigs.	Bovine.
P. XXXIX.	Metropolitan Cattle Market.	May 15, 1906	The specimen was the submaxillary gland of a young pig, the lungs of which were reported to have been slightly affected. The gland was uniformly infiltrated with irregular gritty tubercles the size of millet seeds. At one corner of the gland the tubercles had fused together forming a projecting nodule the size of a split pea. No tubercle bacilli were seen in a smear from the gland.	Submaxillary Gland.	Rabbits and Guinea- pigs.	Bovine.
P. XL.	Metropolitan Cattle Market.	May 15, 1906	The specimens received were the tuberculous submaxillary glands of a young pig, the lungs of which were reported to have shown slight tuberculosis though no disease was found anywhere else in the body. Two submaxillary glands, each the size of a pheasant's egg, were fused together. On section one caseating gritty nodule was seen, the glands being elsewhere composed of gland-like tissue with fine caseous streaks. A smear made from one of the glands showed tubercle bacilli in moderate numbers.	Submaxillary Gland.	Rabbits, Guinea-pigs, and Fowl.	Bovine.

VIRUSES OF PORCINE ORIGIN—continued

Designation of Virus.	Source.	Date of Receipt of Virus.	Description of Animal and Lesions.	Tissue used for Experiment.	Animals Inoculated.	Classification of Virus according to Cultural Characters and Virulence.
P. XLI.	Metropolitan Cattle Market.	May 24, 1906	The specimens received were the submaxillary glands of a young pig about five months old. These glands were not enlarged, and contained caseous gritty tubercles and nodules; the larger nodules (the size of small peas) were formed by aggregated tubercles. A smear from one of the glands showed moderately numerous tubercle bacilli. It was stated that no tuberculosis was seen elsewhere in the body.	Submaxillary Glands.	2 Calves, 5 Pigs, 2 Fowls, Rabbits, and Guinea-pigs.	Human (Group II.)
P. XLII.	Metropolitan Cattle Market.	May 24, 1906	The specimens received were the submaxillary glands from a young pig about eight months old. The lungs and liver were stated to have been very slightly affected. One submaxillary gland, the size of a marble, was caseous throughout, slightly gritty, and beginning to soften. No tubercle bacilli were found in a smear from this gland. Other glands were normal.	Submaxillary Gland.	Rabbits, Guinea-pigs, and Fowls.	Bovine. (Avian bacilli also isolated.)
P. XLIII.	Metropolitan Cattle Market.	June 11, 1906	The specimens received were the submaxillary and inguinal glands of a young sow of which it was reported that no tuberculosis was seen elsewhere in the body. Three of the former glands were enlarged, the size of filberts, and contained discrete yellowish-white tubercles and foci, the majority of which were only calcareous grains. Several other glands were normal. Three smears were made from the submaxillary glands; in one a single tubercle bacillus was found. The inguinal glands were normal.	Submaxillary Glands.	Rabbits and Guinea-pigs.	Bovine.
P. XLIV.	Metropolitan Cattle Market.	June 29, 1906	The specimens received were the submaxillary glands. They were normal in size and showed on section scattered irregular opaque whitish caseous foci up to 1.5 mm. in diameter. A few tubercle bacilli were seen in smears from the glands. It was stated of this pig that no tuberculosis was seen elsewhere in the body.	Submaxillary Glands.	1 Calf, Rabbits, Guinea-pigs, and Fowls.	Avian.
P. XLV.	Metropolitan Cattle Market.	July 2, 1906	The specimens received were the submaxillary glands of a pig, about 12 months old. They were slightly enlarged and moderately closely beset with firm caseous nodules, from a millet seed to a pea in size, which could be readily shelled out of the gland tissue. Six tubercle bacilli were found in a smear from one of the glands. It was stated that no tuberculosis was seen elsewhere in the body.	Submaxillary Glands.	1 Rabbit.	No culture obtained.

P. XLVI.	Metropolitan Cattle Market.	July 2, 1906	The specimens received were the submaxillary glands from a pig about 12 months old. They were not apparently enlarged, and contained scattered discrete caseous gritty nodules up to a hempseed in size; some of the larger ones were softened. Ten tubercle bacilli were found in a smear from one of the glands. It was stated that no tuberculosis was seen elsewhere in the body.	Submaxillary Glands.	2 Calves, 2 Pigs, Rabbits, and Guinea- pigs.	Human (Group II.)
P. XLVII.	Metropolitan Cattle Market.	July 2, 1906	The specimens received were two submaxillary glands from a pig about 12 months old. The glands were not apparently enlarged, but were firmer than normal, and beset with irregular yellow necrotic foci which could not be shelled out. No tubercle bacilli were found in a smear from one of the glands. It was stated that no tuberculosis was seen elsewhere in the body.	Submaxillary Glands.	Rabbits and Guinea- pigs.	Bovine.
P. XLVIII.	Metropolitan Cattle Market.	July 2, 1906	The specimens received were the submaxillary glands from a young pig about 12 months old. They were enlarged and showed on section an irregular coarse caseo-calcareous network embedded in a fibrous matrix. A smear from one of the glands showed numerous tubercle bacilli. It was stated that no tuberculosis was seen elsewhere in the body.	Submaxillary Glands.	Rabbit and Guinea- pig.	No culture isolated.
P. XLIX.	Metropolitan Cattle Market.	August 15, 1906	The specimen received was the submaxillary gland of a young pig, one of six, out of a drove of ten, which were found to be tuberculous. The gland was moderately enlarged and showed on section firm whitish gritty caseous patches and discrete caseous gritty tubercles. No tubercle bacilli were seen in a smear from the gland. It was stated that no tuberculosis was seen elsewhere in the body.	Submaxillary Gland.	Rabbits and Guinea- pigs.	Bovine.
P. L.	Metropolitan Cattle Market.	August 15, 1906	The specimen received was the submaxillary gland of a young pig, another of the six animals mentioned above. The gland was enlarged, dense, and partly composed of dense caseo-calcareous substance, and elsewhere closely beset with discrete caseous gritty tubercles. A smear from the gland showed a few tubercle bacilli. It was stated that there was no tuberculosis elsewhere in the body.	Submaxillary Gland.	Rabbits and Guinea- pigs.	Bovine.
P. LI.	Metropolitan Cattle Market.	October 15, 1906	The specimens received were the submaxillary and inguinal glands from a pig about 12 months old, one of eight, out of a drove of eleven, which were found to be tuberculous. Two submaxillary glands were enlarged, one was caseo-calcareous throughout, the other contained discrete caseo-calcareous nodules and tubercles the remaining gland substance being fibroid. A third small gland contained a few caseous tubercles. The inguinal glands were normal. It was stated that no tuberculosis was seen elsewhere in the body.	Submaxillary Glands.	Rabbits and Guinea- pigs.	Bovine.

VIRUSES OF PORCINE ORIGIN—continued.

Designation of Virus.	Source.	Date of Receipt of Virus.	Description of Animal and Lesions.	Tissues used for Experiment.	Animals Inoculated.	Classification of Virus according to Cultural Characters and Virulence.
P. LII.	Metropolitan Cattle Market.	October 15, 1906	<p>The specimens received were the submaxillary and inguinal glands from a young pig about 12 months old, another of the eight animals mentioned above.</p> <p>Of four submaxillary glands from one side of the neck, three contained discrete caseo-calcareous tubercles, the fourth a pea-sized caseo-calcareous nodule. The glands from the other side were fused together into a mass the size of a pheasant's egg, which was on section almost entirely caseo-calcareous. The inguinal glands were normal. It was stated that no tuberculosis was seen elsewhere in the body.</p>	Submaxillary Glands.	Rabbits and Guinea-pigs.	Bovine.
P. LIII.	Metropolitan Cattle Market.	January 11, 1907	<p>The specimens received were the submaxillary and inguinal glands of a young pig about six months old, one of a herd of 30, 16 of which were found to be tuberculous.</p> <p>The submaxillary glands from either side of the neck were enlarged. They were firm and infiltrated with translucent nodules forming a coarse network with irregular caseo-calcareous streaks in the centres. The inguinal glands were normal.</p>	Submaxillary Glands.	Rabbits, Guinea-pigs, and 1 Fowl.	Bovine.
P. LIV.	Metropolitan Cattle Market.	January 11, 1907	<p>The specimens received were the submaxillary and inguinal glands from a young pig about six months old out of the same herd as the above. The submaxillary glands were enlarged and their substance almost entirely replaced by firm translucent tissue containing a caseo-calcareous network.</p> <p>The inguinal glands were normal.</p>	Submaxillary Glands.	Rabbits, Guinea-pigs, and 1 Fowl.	Bovine.
P. LV.	Metropolitan Cattle Market.	January 11, 1907	<p>The specimens received were the submaxillary and inguinal glands from another six months old pig from the same herd as the above.</p> <p>One large submaxillary gland the size of a hen's egg was firm, and composed of translucent tissue with a close network of caseo-calcareous tissue. Two smaller glands were normal.</p> <p>The inguinal glands were normal.</p>	Submaxillary Glands.	Rabbits and Guinea-pigs.	Bovine.
P. LVI.	Metropolitan Cattle Market.	April 19, 1907	<p>The specimens received were a piece of lung, mesenteric glands, and left fore knee joint, taken from a boar about two years old. The lung contained discrete soft caseous gritty nodules up to 6 mm. in diameter. In the mesenteric glands there were a few miliary calcareous tubercles. The knee joint was ankylosed and formed a rounded mass 5 inches in diameter; in the skin there were several small ulcers over soft caseous nodules, and in the centre of the joint there was a mass of caseo-purulent substance.</p>	Subcutaneous Nodule.	Rabbits and Guinea-pigs.	Bovine.

P. LVII.	Metropolitan Cattle Market.	May 16, 1907	The specimens received were the submaxillary, bronchial, mesenteric, and lumbar glands, and pieces of lung from a young sow. The submaxillary glands were large and extensively caseo-calcareous. The bronchial glands were closely beset with calcaréo-caseous nodules, and the mesenteric and lumbar glands contained a few. The lung showed scattered fibroid nodules with soft caseous centres. It was stated that the liver also contained a few tubercles and that the spleen was normal.	Bronchial Gland.	Rabbits and Guinea- pigs.	Bovine.
P. LVIII.	Metropolitan Cattle Market.	May 27, 1907	The specimens received were from a young sow. The submaxillary glands were caseo-necrotic throughout and slightly gritty. The liver and spleen were beset with caseo-calcareous tubercles up to a millet seed in size. The inguinal glands were large, fibroid and extensively caseated. The mammary gland was beset with soft caseous gritty nodules separated by fibrous tissue.	Mammary Gland.	Rabbits and Guinea- pigs.	Bovine.
P. LIX.	Birmingham.	June 5, 1907	The material received was the synovial membrane from the elbow joint and the submaxillary glands of a pig the carcass of which was stated to have shown tuberculosis of the lungs and all the organs. The submaxillary glands were represented by a mass of caseo-calcareous tissue partly softened. The synovial membrane was closely filled with nodules varying up to a pea in size: the largest consisted of caseous gritty substance enclosed within thin translucent capsules.	Synovial Membrane.	Rabbits and Guinea- pigs.	Bovine.
P. LX.	Birmingham.	June 5, 1907	The specimens received were the submaxillary, bronchial and inguinal glands and spleen from a case of general tuberculosis in a young pig. The submaxillary glands were caseo-calcareous throughout; the bronchial and inguinal glands were similarly affected. In the spleen there were discrete grey nodules with caseous gritty centres varying in size from a millet seed up to that of a large pea.	Spleen.	Rabbits and Guinea- pigs.	Bovine.
P. LXI.	Birmingham.	June 27, 1907	The material received was from a pig stated to be affected with general tuberculosis. The submaxillary glands were enlarged and composed of pinkish caseo-necrotic tissue with calcareous streaks. The bronchial and portal glands were large and caseo-calcareous throughout. The liver contained discrete caseo-calcareous miliary tubercles.	Bronchial Gland.	Rabbits and Guinea- pigs.	Bovine.
P. LXII.	Birmingham.	June 27, 1907	The specimens received were from a pig stated to be affected with general tuberculosis. The submaxillary glands were caseo-necrotic throughout. The spleen and lungs contained numerous soft caseous nodules. There were caseo-calcareous nodules in the lumbar glands.	Spleen.	Rabbits and Guinea- pigs.	Bovine.

VIRUSES OF PORCINE ORIGIN—*continued*.

Description of Virus.	Source.	Date of Receipt of Virus.	Description of Animal and Lesions.	Tissues used for Experiment.	Animals Inoculated.	Classification of Virus according to Cultural Characters and Virulence.
P XLIII.	Birmingham.	July 19, 1907	The specimens received were the submaxillary, bronchial and supra-mammary lymphatic glands, the liver, portions of ribs and dorsal vertebrae. The submaxillary glands showed a few opaque foci and small caseo-calcareous tubercles. The bronchial glands were enlarged and caseo-calcareous throughout. The supramammary glands contained caseous nodules. In the liver there were numerous caseous nodules with gritty centres varying up to a pea in size. In the shaft of a rib there was a large caseating nodule and there were several large caseous masses at the heads of the ribs extending into the costo-vertebral articulations.	Rib.	Rabbits and Guinea-pigs.	Bovine.

CULTURAL CHARACTERS OF, AND GENERAL RESULTS
OF INOCULATION EXPERIMENTS WITH TUBERCLE
BACILLI OF PORCINE ORIGIN.

CULTURAL CHARACTERS OF TUBERCLE BACILLI OF PORCINE ORIGIN.

The following routine method, described more fully in the report on the bovine tubercle bacillus, (Second Interim Report, Appendix, Vol. III., Page 3), has been adopted for the determination of the cultural characters of a particular strain of tubercle bacilli.

The culture isolated from the animal body on the egg medium is maintained on pure serum, and is subcultivated for several generations until it grows readily on this medium. Then from a subculture about seven to ten days old inoculations are made on to the differential media. These consist of serum, serum with 5 per cent. glycerin added, 5 per cent. glycerin agar, glycerinated potato, and 2 per cent. glycerin broth with or without gelatin. Observations are made every seven days on the rate and the characters of the growth on each particular medium until about the end of the sixth week, and are recorded together with a description of the final growth.

The result of this investigation has been to demonstrate that from tuberculous lesions in swine it is possible to isolate cultures of tubercle bacilli, which, according to the character of the growth on media containing glycerin, can be divided into three main groups. The experimental inoculation of animals has shown further that the bacilli in these groups manifest well-marked differences in virulence.

This report deals with the cultural characters of 59 strains of tubercle bacilli isolated from swine.

The cultures of 50 of the viruses are identical with tubercle bacilli derived from bovine animals both in their cultural characters and in their virulence for animals, and will be described in detail under the heading of virulent porcine tubercle bacilli.

Three of the cultures grow more luxuriantly than any bovine culture, resembling those most commonly found in man, and are designated slightly virulent porcine tubercle bacilli (i.e. the human tubercle bacillus.)

Of the remaining six cultures five are avian in character, and are described fully in another report, together with other avian cultures derived from birds.

The last culture (Virus P. XLII.) contained two elements, virulent mammalian tubercle bacilli (bovine tubercle bacilli) and avian tubercle bacilli, which were separated by appropriate methods.

VIRULENT PORCINE TUBERCLE BACILLI.

The great majority of tubercle bacilli obtained from swine falls into this group. So exactly do they resemble in all their reactions tubercle bacilli isolated from bovines that there can be no doubt but that the lesions from which they were obtained were caused by the bovine tubercle bacillus. These virulent porcine tubercle bacilli, like the bovine tubercle bacilli, can be divided roughly into three classes according to their capacity for growing on the test media containing glycerin.

CLASS 1.

The viruses in this class, 25 in number, grow with the most difficulty, and vary very little among themselves; they are distinguished by the initial delay in growing on media containing glycerin, a feature which they retain after prolonged cultivation on pure serum.

Viruses.	Cultural Characters.
P.I., V., XVI., XVII., XVIII., XIX., XXII., XXIII., XXVI., XXIX., XXXI., XXXIII., XXXIV., XXXVI., XXXVII., XL., XLVII., XLIX., L., LI., LII., LVI., LVII., LIX., LX.	On pure serum they produce a dry, usually even grey layer which does not increase after the second or third week: on the same serum with the addition of 5 per cent. glycerin no growth occurs during the first week, but in the second or third weeks discrete colonies appear which may subsequently coalesce, forming a rough warty, greyish white layer. On glycerin agar and glycerinated potato there is the same initial delay with the subsequent formation of discrete colonies which may attain a considerable size. On glycerin broth there is often considerable difficulty in obtaining growth: a very thin, almost transparent grey pellicle may be formed, but more often the surface is covered with islands of growth.

CLASS 2.

The viruses in this class, 15 in number, exhibit greater variation among themselves than the preceding, very few being exactly alike. Some grow little better than those in the first class, while others approach in luxuriance those in Class 3. The following description applies to the intermediate viruses:—

Viruses.	Cultural Characters.
P. VI., VII., VIII., XIII., XIV., XX., XXX., XXXII., *XLII., XLIII., LII., LV., LXI., LXII., LXIII.	On glycerin serum and serum alone almost equal growths are obtained, that on the former being usually rougher and whiter. On glycerin agar and glycerinated potato thin grey translucent layers with a few whiter raised colonies are formed which may subsequently attain a considerable size. The pellicle on broth is usually complete but thin and translucent.

CLASS 3.

In Class 3 are included the remaining 11 viruses which grow most readily and abundantly on the test media.

Viruses.	Cultural Characters.
P. IX., X., XI., XII., XV., XXIV., XXV., XXXVIII., XXXIX., LIV., LVIII.	On glycerin serum growth is much more luxuriant and is continued for a longer time than on serum alone; in appearance it is fairly thick, greyish white, rough and nodular on the surface and often slightly wrinkled. On glycerin agar the growth quickly covers the surface with a dry greyish white layer finely wrinkled and opaque in parts but often somewhat moist and greasy in appearance. Growth usually ceases in about three or four weeks, but sometimes discrete raised colonies grow up to a considerable size. Growth on potato is usually in the form of a grey or greyish white layer of only moderate thickness; occasionally individual colonies become raised and warty. On broth a complete pellicle is formed fairly readily, but it is usually translucent and never completely opaque; it is apt to become moist and sink in about three to four weeks.

SLIGHTLY VIRULENT PORCINE TUBERCLE BACILLI.

Three of the porcine viruses are slightly virulent for calves and rabbits and grow much more luxuriantly than any virulent virus. Their characters are identical with those of the human tubercle bacillus. No distinction of any value can be made between them: there has been a little difficulty in obtaining a good growth on glycerin agar, but after repeated attempts in all cases a characteristically luxuriant growth has finally resulted.

Viruses.	Cultural Characters.
P. IV., XLI., XLVI.	On serum the total amount of culture is much greater than with the virulent viruses, and there is often formed a bright yellow or orange pigment. The growth on glycerin serum is invariably more abundant than on serum alone and more pigmented. On glycerin agar growth takes place from the outset, and a thick continuous creamy highly wrinkled, sometimes warty, layer is quickly formed. On potato the growth is raised, warty, nodular, or wrinkled and deeply pigmented. The pellicles produced on glycerin broth and glycerin gelatin are much thicker than those produced by the virulent viruses, and are for the most part opaque, whitish or creamy, wrinkled and sometimes warty. On medicine bottles containing about 40 cc. of broth the pellicle is often thick and felt-like and fails to cover the surface completely.

* Mammalian element of the mixture.

GENERAL SUMMARY OF INOCULATION EXPERIMENTS ON RABBITS WITH TUBERCLE BACILLI OF PORCINE ORIGIN.

RABBITS have been systematically employed in this investigation for determining the virulence of a virus since the previous investigations of tubercle bacilli of human and bovine origin have proved that they furnish a reliable means of differentiating between tubercle bacilli of high and low bovine virulence. And furthermore, by means of this animal alone a definite decision as to the nature of a virus can be made from the consideration of the character of the lesions (with reference to their extent and distribution) produced by the various forms of inoculation. It has therefore been considered unnecessary, when a porcine culture exhibiting the cultural characters of a bovine tubercle bacillus has produced in rabbits tuberculosis identical with that set up by a tubercle bacillus of bovine origin, to test in every instance its virulence for the bovine animal.

On the other hand, when a virus has caused in rabbits tuberculosis differing in extent and distribution from that set up by the bovine tubercle bacillus it has in every case been tested as to its virulence for calves and also for other species of animals.

The results of the inoculation of rabbits have shown that the bacilli isolated from tuberculous lesions in swine can be divided into three groups, exhibiting respectively the properties of the bovine, human and avian tubercle bacilli. Of the 59 viruses investigated, 50 were virulent for rabbits, 3 were slightly virulent, and 5 gave results identical with those produced by bacilli isolated from tuberculous lesions in birds. The remaining virus was a mixture of bovine and avian tubercle bacilli.

The experiments with the first two groups only are considered here, the avian bacilli being considered together with other strains of avian bacilli isolated from birds.

Cultures of the viruses in these two groups have all been inoculated into rabbits intravenously, intraperitoneally, and subcutaneously in varying doses. The subculture inoculated has been grown on bovine serum and the age has been about 21 days; the period in which the cultures have been in cultivation since isolation has varied from 75 to 281 days.

Tables have been made out giving a summary of the general results under the heading of each form of inoculation and each particular dose.

All the rabbits inoculated with the virulent viruses with the exception of one which was killed and those which succumbed to some intercurrent disorder have died of general tuberculosis. The results have been given briefly in the tabular summaries as general tuberculosis, since the types of disease produced by the several forms of inoculation are so characteristic that a general description of the lesions will suffice for each form. The culture from the original material of Virus P. XIV. has been inoculated into several series of rabbits, the total age of the cultures varying from 290 to 690 days: the apparent diminution in virulence indicated by the longer duration of life of the animals inoculated with the older cultures (*see* Table, pages 240-241) is probably only a manifestation of the general irregular virulence of the virus.

The rabbits inoculated with cultures of the slightly virulent tubercle bacilli developed a much more chronic disease and were with some exceptions in good health when killed after about three months. A general description of the lesions produced by the slightly virulent bacilli is given under each form of inoculation, but on account of the greater variation in the extent of the disease a detailed account of the post-mortem examination of each rabbit is also given in the tabular summaries.

Rabbits have been inoculated with emulsions of the original material of many of the viruses and the results which have been summarised in the form of a table (page 196) correspond in general with those obtained by the inoculation of the cultures. They have served to give a preliminary indication of the virulence of a virus: for example a rabbit inoculated with the original material of Virus P. XLVI., which proved to be a slightly virulent virus, showed no tuberculosis. And in every case in which the inoculation of the original material has caused progressive tuberculosis in a rabbit the culture isolated has proved to be virulent.

SUMMARY OF LESIONS PRODUCED IN RABBITS BY VIRULENT CULTURES UNDER EACH FORM OF INOCULATION.

INTRAVENOUS INOCULATIONS.

After an intravenous inoculation of 1.0 mg. of culture the rabbit dies of acute tuberculosis in from 9 to 20 days: after 0.1 mg. in from 11 to 26 days.

The disease produced by this form of inoculation is very acute and certain in its effects in doses of 1.0 mg. and 0.1 mg. of culture. Large numbers of tubercle bacilli are at once distributed throughout the body and the lesions which develop are numerous and wide-spread quickly leading to the death of the animal.

On examination after death the appearances are as follows: the lungs do not collapse and are closely filled with milary caseating tubercles which in many cases cause complete consolidation especially of the small anterior lobes. The spleen is swollen and firm in consistency and the substance is speckled with grey points most evident just beneath the capsule. The liver substance is similarly closely beset with grey foci which are usually not evenly distributed but form a kind of network most clearly visible on the surface and corresponding with the lobules of the liver. The kidneys show a variable number of quite translucent tubercles in the cortices with here and there a central focus of caseation. Caseous foci are often visible in the lymphatic glands, especially in the bronchial which are enlarged and oedematous.

There is little difference in the effects of the doses of 0.1 mg. and 1.0 mg., the lesions produced by the smaller dose being more evident from the longer duration of life.

INTRAPERITONEAL INOCULATIONS.

After an intraperitoneal inoculation of 1.0 mg. of culture the rabbit dies of acute tuberculosis in from 10 to 29 days: after 0.1 mg. in from 13 to 48 days: after 0.01 mg. in from 23 to 52 days.

In the intraperitoneal inoculation as in the intravenous numerous tubercle bacilli gain access to the blood stream and with the larger doses the type of disease is very similar with the addition of peritoneal tuberculosis. After a dose of 1.0 mg. or 0.1 mg. the omentum is thickened, retracted and composed of translucent tissue with varying amounts of caseation. The parietal and visceral peritoneum are closely covered with minute tubercles most numerous on the caecum, the mesentery and the mesocolon. The lesions in the organs resemble those resulting from an intravenous inoculation, though the lungs are seldom so severely affected. Most commonly they collapse partially and contain numerous discrete caseous tubercles.

After a dose of 0.1 mg. the animal lives longer and the omentum becomes greatly enlarged and extensively caseated: the tubercles on the peritoneum are more sparsely distributed and attain a greater size.

It occasionally happens in the use of this method of inoculation that the whole of the dose administered is not deposited in the peritoneal cavity, the inoculation being made partly into the subcutaneous tissues or muscles of the abdominal wall or into the

lumen of the caecum. In the event of any of these accidents the intraperitoneal dose may be very small and the disease produced is very chronic in type resembling that following a subcutaneous inoculation. When the inoculation is partly intra-caecal a caseous nodule ulcerated internally is formed in the wall of the gut and a careful examination of this organ should always be made if the duration of life of a rabbit after inoculation exceeds the usual limit.

SUBCUTANEOUS INOCULATIONS.

After a subcutaneous inoculation of 10.0 mg. of culture, the rabbit dies of general tuberculosis in from 28 to 101 days; after 1.0 mg., in from 29 to 165 days; after 0.1 mg., in from 53 to 146 days; and after 0.01 mg., in from 69 to 125 days.

When virulent tubercle bacilli are inoculated under the skin in doses varying from 0.01 mg. to 10.0 mg., fatal tuberculosis is almost invariably produced, but the disease runs a much more chronic course than with either the intravenous or intraperitoneal inoculations.

At the seat of inoculation a caseous tumour is formed, which usually ulcerates through the skin, and the nearest lymphatic glands enlarge and caseate. The lungs and kidneys are the organs most severely affected, and the immediate cause of death is usually from the mechanical effect of destruction of the lung tissue. In a typical case the lungs fill the pleural cavities and are represented by caseous masses with confluent margins of grey translucent tissue. In very chronic cases these caseous masses may soften in the centre, with the formation of cavities. The cortices of the kidneys are filled with caseating nodules, varying in number and size. The larger nodules project prominently above the surface and on section have a wedge shape; often they are adherent to the capsule,

and may be drawn out of the substance in the process of stripping the kidney. The liver and spleen are often very slightly affected, and contain a varying number of caseous nodules up to a hemp seed in size. The lymphatic glands, apart from those adjacent to the local lesion, are never much enlarged, and contain a few discrete caseous nodules. The thyroid body has often been found to be tuberculous, containing caseous tubercles or nodules which sometimes replace almost the whole of the gland substance.

In very chronic cases the intestines occasionally show large caseous nodules projecting on the peritoneal surface and ulcerated internally. In one instance a knee joint was swollen and filled with a mucinous caseous substance.

The inoculation into the subcutaneous tissues of the back is more severe than the inoculation into the subcutaneous tissues of the abdomen, and the duration of life is considerably shortened.

With regard to the value of the subcutaneous method of inoculation, the results have clearly shown that it is the most reliable method of establishing the differences in virulence between strains of tubercle bacilli.

COMPARISON OF RESULTS WITH TUBERCLE BACILLI OF PORCINE AND BOVINE ORIGIN.

A comparison of the results of the inoculation of rabbits with virulent tubercle bacilli of porcine and bovine origin, shows that fatal general tuberculosis is almost invariably produced in both cases, and the extent and distribution of the lesions are essentially the same. There is also a remarkably close correspondence in the average duration of life of rabbits inoculated by the same methods and with equivalent doses, as will be seen by reference to the table on page 171, where the results are given in parallel columns.

SUMMARY OF THE LESIONS PRODUCED IN RABBITS BY THE SLIGHTLY VIRULENT PORCINE CULTURES.

INTRAVENOUS INOCULATIONS.

The rabbits inoculated intravenously with 0.1 mg. or 1.0 mg. were all killed after the lapse of about three months.

On post-mortem examination the lungs collapse and show mainly on the surface and in the thin margins a variable number of hard grey tubercles with caseous centres and irregular grey patches, up to several millimetres in diameter, beset with caseous foci. The bronchial glands may or may not contain caseous tubercles.

The surfaces of the kidneys are pitted and scarred and show a variable number of grey nodules with soft caseous centres many of which extend as soft caseous streaks into the medulla often to the apex of the papilla; in the pelvis of either one or the other kidney, or of both, there may be a quantity of thick caseous pus. The liver and spleen have never been affected.

Soft caseous miliary tubercles, containing large numbers of tubercle bacilli, are almost invariably found in the muscles of the trunk and limbs. The rabbits inoculated with culture of Virus P. IV. were more severely affected than those inoculated with Virus P. XII. and P. XLVI., the dorsal surfaces of the caudal lobes of the lungs being covered with large caseous patches.

INTRAPERITONEAL INOCULATIONS.

A rabbit inoculated with 10 mg. of Virus P. IV. died of acute tuberculosis in 18 days, the disease resembling that set up by a dose of 1.0 mg. of virulent culture; the lesions, however, were fewer, not so caseous, and contained less numerous tubercle bacilli.

Another rabbit inoculated with 0.1 mg. of

Virus P. IV. died after 333 days of chronic general tuberculosis; the lungs were almost completely replaced by cystic caseous nodules and there were large fibro-caseous masses on the pleura, diaphragm, and pericardium; cultures isolated from the lung and the omentum grew as luxuriantly as the original culture.

All the other rabbits inoculated intraperitoneally were killed after periods of about three months and showed chronic general tuberculosis similar to but rather less extensive than that which follows an intravenous inoculation.

In these cases the omentum is not rolled up and contains a varying number of grey or greyish white tubercles usually gritty in the centre and often aggregated together; similar tubercles are seen on the mesentery and mesocolon clustered together in a characteristic manner in the centres of the regions bounded by the mesenteric vessels.

SUBCUTANEOUS INOCULATIONS.

The disseminated lesions produced by this form of inoculation are fewer in number and less in extent than with either of the two preceding forms.

At the seat of inoculation a circumscribed tumour develops which may attain a considerable size and always softens; it rarely ulcerates through the skin. The nearest glands are enlarged and contain softened caseous nodules.

The lungs are normal in general appearance and show on the surface a few grey tubercles and nodules only. Other organs and glands are normal with the exception of occasional slight disease in the kidneys. This form of inoculation brings out more sharply than any other the difference in virulence for rabbits that exists between the virulent and slightly virulent strains of tubercle bacilli.

A.						B.				
VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.						VIRULENT TUBERCLE BACILLI OF BOVINE ORIGIN.				
Method of Inoculation.	Dose.	Number of Rabbits.	Duration of Life in Days.	Average.		Method of Inoculation.	Dose.	Number of Rabbits.	Duration of Life in Days.	Average.
Intravenous	1·0 mg.	29	9—20	14·8		Intravenous	1·0 mg.	13	10—21	14·3
"	0·1 mg.	52	11—26	18·9		"	0·1 mg.	47	11—34	20·3
Intraperitoneal	1·0 mg.	38	10—29	17·9		Intraperitoneal	1·0 mg.	53	11—38	17·8
"	0·1 mg.	41	13—48	27·6		"	0·1 mg.	33	14—40	22·9
"	0·01 mg.	13	23—52	34·2		"	0·01 mg.	9	22—65	35·0
Subcutaneous	10·0 mg.	18	28—101	53·7		Subcutaneous	10·0 mg.	—	—	—
"	1·0 mg.	48	29—165	69·8		"	1·0 mg.	52	38—126	72·8
"	0·1 mg.	25	53—146	87·2		"	0·1 mg.	26	49—137	87·6
"	0·01 mg.	12	69—125	89·3		"	0·01 mg.	—	—	—
Subcutaneous in tissues of back	1·0 mg.	11	40—86	65·9		Subcutaneous in tissues of back	1·0 mg.	10	—	62·9
Subcutaneous in tissues of abdomen...	1·0 mg.	23	51—165	77·7						

GENERAL SUMMARY OF INOCULATION EXPERIMENTS WITH TUBERCLE BACILLI OF PORCINE ORIGIN ON CALVES, PIGS, GUINEA-PIGS, AND RATS.

CALVES.

VIRULENT VIRUSES.

Fourteen calves have been inoculated subcutaneously each with 50 milligrammes of culture derived from seven of the virulent viruses. Six of the cultures tested have proved equal in virulence to tubercle bacilli of bovine origin and have caused the death of the calves in from 19 to 48 days, setting up in every case severe general tuberculosis. Cultures derived from the original material of the remaining Virus (P. XIV.) have been inoculated into four calves and have caused only moderately severe tuberculosis. This culture is definitely less virulent than any culture from a bovine source, but after a single passage through the calf it became fully virulent. The two calves inoculated with the first passage culture died of severe general tuberculosis in 46 and 32 days respectively, while of the four calves inoculated with the culture of the original material two died in 76 and 80 days, and two were killed after 87 and 104 days with tuberculosis only of moderate severity.

A calf was inoculated intravenously with 50 milligrammes of culture of Virus P. XXIX. and died of acute tuberculosis in 16 days.

SLIGHTLY VIRULENT VIRUSES.

Ten calves have been inoculated subcutaneously with doses varying from 34 to 200 milligrammes of culture derived from the three slightly virulent viruses P. IV., P. XLI., P. XLVI. All of the animals but one showed after periods varying from 90 to 105 days only slight and non-progressive tuberculosis. The single exception was a calf, No. 312, which was inoculated with culture of Virus P. IV., and showed 90 days later tuberculous consolidation of the dorsal parts of the caudal lobes of the lungs with only slight disease elsewhere: the animal became very unwell in the fifth week after the inoculation with considerable respiratory distress and seemed likely to die: it is possible that the lung condition had been worse at that time and was in progress to recovery when the animal was killed. Calf 314 inoculated at the same time with 34 milligrammes showed after 135 days an extremely slight amount of tuberculosis.

PIGS.

None of the virulent viruses has been tested in pigs.

The three slightly virulent viruses have been tested on 11 pigs, seven inoculated subcutaneously and four by feeding.

Eight of the pigs when killed were in good condition and showed only slight non-progressive tuberculosis.

One pig, No. 166, inoculated subcutaneously with 50 milligrammes of culture of Virus P. XLI., when killed after 102 days had extensive tuberculous consolidation of the lungs without any sign of caseation: the bronchial and dorsal mediastinal glands were normal in appearance: the kidneys contained in the cortices yellowish grey nodules. Guinea-pigs inoculated with the substance of the liver, spleen, lungs and kidneys became tuberculous. The culture isolated from the lung of the pig grew like the original culture, and was inoculated into another pig and into rabbits. The second pig, No. 202, died after 64 days of a similar pneumonic condition of the lungs, and from the lung a culture was isolated possessing the characters of the original culture. This culture was inoculated subcutaneously into a third pig, No. 258, which succumbed to a tuberculous broncho-pneumonia in 103 days. The cultures

recovered were unaltered in characters and remained slightly virulent for rabbits. The interest of this experiment lies in the fact that a culture resembling closely the common human tubercle bacillus, caused when inoculated subcutaneously fatal tuberculosis in three pigs in succession without showing alteration in characters or virulence for rabbits.

GUINEA-PIGS.

Guinea-pigs have been inoculated intraperitoneally and subcutaneously with all the viruses, and in every case death from general tuberculosis has resulted. The lesions produced by the slightly virulent viruses have on the whole been less acute than those set up by the virulent, but there have not been sufficient experiments with the former to enable any conclusions to be drawn from a comparison of the duration of life.

Guinea-pigs inoculated intraperitoneally with doses of 0.1 mg. of virulent porcine cultures have died of acute tuberculosis in from 10 to 27 days, the average duration of life of 48 guinea-pigs being 16.2 days. The duration of life after a similar inoculation of bovine tubercle bacilli is from 10 to 31 days; average 17.8.

Guinea-pigs inoculated subcutaneously with doses of 0.1 mg. of virulent porcine cultures have died of general tuberculosis in from 26 to 83 days, the average duration of life of 50 guinea-pigs being 44.9 days. The duration of life after a similar inoculation of bovine tubercle bacilli is from 22 to 74 days; average 44.1.

Guinea-pigs were almost invariably inoculated with emulsions of the original material. Out of the total of 49 guinea-pigs five died of acute infections, three showed no tuberculosis, and 36 developed general tuberculosis. The five remaining guinea-pigs were inoculated with the original material from which the avian cultures were isolated: four developed local tuberculosis only, and the fifth remained healthy.

RATS.

Nine rats have been inoculated, six intraperitoneally and three subcutaneously, with cultures from four of the virulent viruses; and three rats, two intraperitoneally and one subcutaneously, with culture from the slightly virulent Virus P. IV., the doses varying from 5 to 40 mg.

The general results are the same as those produced by the inoculation of bovine and human tubercle bacilli from other sources—there is a wide distribution of bacilli over the body without the formation of characteristic tuberculous lesions.

All the rats inoculated intraperitoneally died, except one which was killed accidentally, and numerous tubercle bacilli were found in smear preparations from the organs; except for some small nodules on the peritoneum in some of the cases none of the animals showed definite tuberculous lesions, the only signs of infection being enlargement of the spleen and congestion of the lungs, or, as occurred in one case, pneumonic consolidation.

One of the rats inoculated subcutaneously died in 33 days from a non-tuberculous affection of the lungs; the other three were killed in periods varying from 211 to 253 days. Nothing of a tuberculous nature were seen beyond the site of inoculation, but in all cases tubercle bacilli were found in the organs, their number, however, being much less than in animals inoculated intraperitoneally.

TABULAR SUMMARIES OF THE INOCULATION
EXPERIMENTS.

TABULAR SUMMARY OF INOCULATION EXPERIMENTS ON CALVES WITH CULTURES OF
VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.

SUBCUTANEOUS INOCULATIONS.

Virus.	Strain.	Dose.	Generation and Age of Sub-culture inoculated.	Total period under Cultivation.	Number of Calf.	Weight in kilos.	Duration of Life.	Result.
P. V.	Original material.	50 mg.	7th generation, 20 days old.	134 days	336	29.48	Died, 29 days	General tuberculosis severe.
P. VI.	Original material through G.P. 1,515.	50 mg.	6th generation, 20 days old.	126 days	326	41.27	Killed when very ill, 29 days.	General tuberculosis severe.
P. VIII.	Original material.	50 mg.	5th generation, 20 days old.	117 days	328	34.00	Died, 28 days	General tuberculosis severe.
P. IX.	Original material.	50 mg.	7th generation, 20 days old.	125 days	334	41.72	Died, 45 days	General tuberculosis severe.
P. XI.	Original material.	46.5 mg.	4th generation, 20 and 21 days old.	97 days	338	31.75	Died, 37 days	General tuberculosis severe.
P. XII.	Original material through G.P. 1,636.	50 mg.	5th generation, 20 days old.	101 days	376	39.46	Killed when dying, 19 days.	General tuberculosis severe.
		50 mg.	9th generation, 21 days old.	298 days	444	37.19	Killed when dying, 48 days.	General tuberculosis severe.
		50 mg.	9th generation, 21 days old.	298 days	450	36.74	Died, 41 days	General tuberculosis severe.
P. XIV.	Original material through G.P. 1,623.	50 mg.	12th generation, 21 days old.	290 days	446	36.74	Died, 80 days	Slight general tuberculosis. Death from cystitis and nephritis, caused by urinary calculi.
		50 mg.	12th generation, 21 days old.	290 days	448	31.75	Killed when moderately well, 104 days.	General progressive tuberculosis of moderate severity.
		50 mg.	21st generation, 21 days old.	581 days	532	39.90	Died, 76 days	General tuberculosis severe in the lungs.
	Calf 448 (Lung).	50 mg.	21st generation, 21 days old.	581 days	534	54.87	Killed when well, 87 days.	General progressive tuberculosis of moderate severity.
		50 mg.	8th generation, 21 days old.	187 days	536	58.50	Died, 46 days	General tuberculosis severe.
		50 mg.	8th generation, 21 days old.	187 days	538	43.99	Died, 32 days	General tuberculosis severe.

INTRAVENOUS INOCULATION.

P. XXIX.	Original material.	50 mg.	12th generation, 24 days old.	383 days	454	131.98	Died, 16 days.	General tuberculosis.
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TABULAR SUMMARY OF INOCULATION EXPERIMENTS ON CALVES WITH CULTURES OF SLIGHTLY VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.
SUBCUTANEOUS.

Virus.	Strain.	Dose.	Generation and age of subculture inoculated.	Total period under Cultivation.	No. of Calf.	Weight in kilos.	Duration of Life.	Result.
P. IV.	Original material.	50 mg.	11th generation, 21 days old.	183 days	350	33.10	Killed when well. 90 days.	Small fibro-caseous local tumour. The left prescapular gland showed more than a third of the cortex caseo-calcareous. The thoracic glands contained few minute foci. One tubercle was seen in a coeliac gland, and one in the lung.
"	"	50 mg.	7th generation, 20 days old.	120 days	312	36.74	Killed when in fair health. 90 days.	Fibro-caseous local tumour. Prescapular gland largely composed of caseated tissue. In the lung were moderately numerous transparent tubercles irregularly distributed, and portions of the caudal lobes were consolidated. The suprarenals contained fairly numerous small tubercles. Several lymph glands contained one or more small foci.
"	"	34 mg.	" "	"	314	33.55	Killed. 135 days	Thin-walled cyst containing caseo-pus at seat of inoculation. Prescapular gland largely caseo-calcareous. The mesenteric glands contained minute calcareous tubercles; a single tubercle was seen in a thoracic gland.
"	Calf 312 (lung).	50 mg.	4th generation, 20 days old.	258 days	356	56.69	Killed when well. 105 days.	Fibroid local tumour, containing thick pus in a central cavity. Small caseous and calcareous tubercles in the left prescapular gland. No tuberculosis elsewhere.
"	"	50 mg.	" "	"	358	63.50	Killed when well. 93 days.	Thin-walled cyst at seat of inoculation containing caseo-pus and watery fluid. In the left prescapular gland was a caseo-calcareous mass. One or two minute tubercles were seen in a mediastinal and a portal gland, and in lung (?).
"	Calf 358 (Prescap. gland).	200 mg.	5th generation, 21 days old.	86 days	426	29.02	Died. 29 days Death due to diarrhoea.	Caseo-necrotic tumour. The adjacent glands were firm, and infiltrated with a yellow caseous network. Moderate numbers of minute grey tubercles were seen in the lungs; there were numerous similar tubercles in the liver.
P. XLI.	Original material.	50 mg.	8th generation, 21 days old.	175 days	478	73.48	Killed when well. 99 days.	Fibrous-walled cyst containing caseo-purulent substance at seat of inoculation; caseo-calcareous nodules in prescapular gland. There was a tuberculous nodule adjacent to the gland. No tuberculosis elsewhere.
"	"	100 mg.	" "	"	480	68.90	Killed when well. 98 days.	Fibrous-walled cyst at seat of inoculation containing turbid fluid and caseous masses. In the left prescapular gland were two caseo-calcareous nodules. The left prepectoral gland showed caseo-calcareous streaks in a translucent network. A few scattered grey tubercles were seen in the liver.
P. XLVI.	Original material.	50 mg.	7th generation, 21 days old.	136 days	484	48.50	Killed when well. 102 days.	Fibrous-walled cyst at seat of inoculation containing caseo-pus. In the left prescapular gland was a single soft caseous nodule. The liver showed some irregular grey foci.
"	"	75 mg.	" "	"	486	51.70	Killed when well. 105 days.	Fibrous-walled cyst at seat of inoculation containing turbid fluid and caseous flakes. The left prescapular and prepectoral glands each contained a single caseous nodule. Two bronchial glands contained minute foci.

TABULAR SUMMARY OF INOCULATION AND FEEDING EXPERIMENTS ON PIGS WITH CULTURES OF SLIGHTLY VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.

Virus.	Strain.	Dose.	Generation and Age of Subculture Inoculated.	Total period under Cultivation.	No. of Pig.	Weight in Kilos.	Method of Inoculation.	Duration of Life.	Result.
P. IV.	Original material.	1.0 mg.	11th generation, 21 days old.	183 days	124	10.0	Fed	Killed, 118 days	A submaxillary gland on each side contained a moderate number of caseous gritty nodules. One mesenteric gland showed two caseous gritty tubercles. Two caseo-calcareous tubercles in the lungs. One portal and one bronchial gland contained two pinhead sized tubercles. No tuberculosis elsewhere.
"	"	1.0 mg.	" "	"	126	8.5	Subcut.	Killed, 114 days	Caseous gritty encapsuled nodule the size of a broad bean at the seat of inoculation. Inguinal glands moderately caseated. A few yellowish tubercles in two portal glands. Discrete caseous gritty submiliary tubercles in the lungs. A few caseo-calcareous tubercles in the mesenteric glands.
"	Calf 312 (Lung).	1.0 mg.	4th generation, 20 days old.	126 days	132	26.0	Subcut.	Killed, 122 days	Fibro-caseous gritty local tumour. Caseous gritty nodules in the inguinal glands. Three small tubercles in the liver. Caseo-calcareous tubercles in the portal glands. In the lungs there were ten glassy tubercles. Ventral mediastinal gland caseated. A few foci in coeliac and bronchial glands.
"	"	1.0 mg.	" "	"	134	20.25	Fed	Killed, 128 days	Caseous gritty nodules in the submaxillary glands. A single grey tubercle in the lung. Other organs and glands normal.
P. XLI.	Original material.	50.0 mg.	10th generation, 21 days old.	245 days	166	—	Subcut.	Killed, 102 days	At the seat of inoculation there were two small ulcers and a few miliary caseo-calcareous tubercles in the subcutaneous tissue. Caseation of inguinal and ventral mediastinal glands. Extensive tuberculous consolidation of the lungs. Grey fibroid tubercles on pleura and diaphragm. Caseous miliary tubercle in spleen. Moderately numerous yellowish grey nodules in the kidneys. One tubercle in a suprarenal body.
"	"	50.0 mg.	" "	"	172	—	Fed	Killed, 98 days	A submaxillary gland on each side contained caseous slightly gritty nodules. The mesenteric glands showed caseous nodules up to a pea in size. In the liver there was one caseous tubercle. A few tubercles were seen in the portal glands. There were scattered glassy tubercles in the lungs.
"	Pig 166 (Lung).	50.0 mg.	7th generation, 20 days old.	484 days	202	29.0	Subcut.	Died, 64 days	Cyst filled with caseo-pus at the seat of inoculation. Right inguinal and sternal glands caseous and softened. Lungs extensively consolidated (T.B.). Caseous tubercles in the bronchial and mediastinal glands. A few pale areas in the kidneys. No tuberculosis elsewhere.
"	Emulsion of Lung of Pig 202.	9.0 cc.	—	—	228	19.95	Subcut.	Killed, 166 days	Cyst filled with soft caseous gritty substance at the seat of inoculation. Caseous nodules in the inguinal glands. In the lungs there were a few translucent foci. No tuberculosis elsewhere.
"	Pig 202 (Lung).	50.0 mg.	7th generation, 16 days old.	110 days	258	18.14	Subcut.	Died, 103 days	Caseo-purulent cyst at the seat of inoculation. Left inguinal and sternal glands enlarged, caseous, and softened. Severe tuberculous consolidation of the lungs. Bronchial glands firm (T.B. numerous). Opaque patches in various lymphatic glands. No disease elsewhere.

P. XLVI.	Original material.	50.0 mg.	9th generation, 21 days old.	206 days	164	—	Subcut.	Killed, 97 days	Caseo-purulent cyst in the subcutaneous tissue and discrete caseo-calcareous tubercles at the seat of inoculation. Left inguinal and ventral mediastinal glands partly caseated. A very few translucent and opaque foci in the lungs.
"	"	50.0 mg.	" "	"	163	—	Fed	Killed, 60 days	Submaxillary glands beset with discrete fibro-caseous tubercles. All the mesenteric glands contained caseo-calcareous tubercles up to a hemp seed in size. Caseous foci in the colic glands. In the lungs there were six translucent tubercles.

INTRAVENOUS INOCULATIONS OF RABBITS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.

DOSE IN EACH CASE : 1.0 milligramme.

Virns.	Source of Culture.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
					Initial.	Final.			
P. XIV.	Original material	21 days old, 23rd generation	672 days	1407	1,250	920	July 16th, 1907	Died 21 days	General tuberculosis
P. XXII.	Original material	21 days old, 4th generation	77 days	607	1,480	900	Dec. 14th, 1905	Died 14 days	General tuberculosis.
P. XXX.	Original material	19 days old, 6th generation	132 days	851	1,470	1,070	May 1st, 1906	Died 15 days	General tuberculosis.
P. XXXI.	Original material	20 days old, 6th generation	140 days	861	1,750	1,220	May 9th, 1906	Died 12 days	General tuberculosis.
P. XXXII	Original material	21 days old, 7th generation	143 days	850	1,500	1,050	July 5th, 1906	Died 12 days	General tuberculosis.
P. XXXIII.	Original material	22 days old, 7th generation	140 days	972	1,520	1,160	July 5th, 1906	Died 11 days	General tuberculosis.
P. XXXIV.	Original material	22 days old, 7th generation	140 days	978	1,930	1,300	July 6th, 1906	Died 13 days	General tuberculosis.
P. XXXVI.	Original material	21 days old, 10th generation	245 days	1093	3,560	2,450	Nov. 23rd, 1906	Died 18 days	General tuberculosis.
P. XXXVII.	Original material	21 days old, 10th generation	245 days	1099	3,400	2,220	Nov. 23rd, 1906	Died 19 days	General tuberculosis.
P. XXXVIII.	Original material	21 days old, 8th generation	193 days	1105	3,900	2,660	Nov. 24th, 1906	Died 15 days	General tuberculosis.
P. XXXIX.	Original material	14 days old, 10th generation	281 days	1252	1,920	1,550	Feb. 20th, 1907	Died 13 days	General tuberculosis.
P. XL.	Original material	21 days old, 8th generation	196 days	1120	2,300	1,820	Nov. 27th, 1906	Died 17 days	General tuberculosis.
P. XLII.	Original material	21 days old, 8th generation	177 days	1072	1,100	940	Nov. 17th, 1906	Died 13 days	General tuberculosis.

INTRAVENOUS INOCULATIONS OF RABBITS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN—*continued*.

DOSE IN EACH CASE: 1.0 milligramme—*continued*.

Virus.	Source of Culture.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
					Initial.	Final.			
P. XLIII.	Original material	21 days old, 6th generation	169 days	1129	3,100	2,070	Nov. 28th, 1906	Died 16 days	General tuberculosis.
P. XLVII.	Original material	21 days old, 8th generation	183 days	1144	1,920	1,600	Dec. 4th, 1906	Died 16 days	General tuberculosis.
P. XLIX.	Original material	21 days old, 6th generation	157 days	1203	2,000	1,450	Jan. 19th, 1907	Died 14 days	General tuberculosis.
P. L.	Original material	25 days old, 7th generation	141 days	1174	1,170	1,000	Jan. 3rd, 1907	Died 12 days	General tuberculosis.
P. LI.	Original material	16 days old, 5th generation	95 days	1190	2,300	1,650	Jan. 18th, 1907	Died 11 days	General tuberculosis.
P. LII.	Original material	20 days old, 5th generation	95 days	1197	1,550	1,220	Jan. 18th, 1907	Died 9 days	Early general tuberculosis.
P. LIII.	Original material	21 days old, 8th generation	185 days	1397	1,800	1,330	July 15th, 1907	Died 14 days	General tuberculosis.
P. LIV.	Original material	21 days old, 7th generation	185 days	1399	1,720	1,150	July 15th, 1907	Died 19 days	General tuberculosis.
P. LV.	Original material	22 days old, 7th generation	186 days	1403	2,150	1,320	July 16th, 1907	Died 16 days	General tuberculosis.
P. LVI.	Original material	21 days old, 5th generation	143 days	1440	1,600	1,140	Sept. 9, 1907	Died 15 days	General tuberculosis.
P. LVII.	Original material	21 days old, 5th generation	117 days	1448	1,850	1,430	Sept. 10, 1907	Died 13 days	General tuberculosis.
P. LVIII.	Original material	21 days old, 6th generation	129 days	1500	3,530	2,650	Oct. 3, 1907	Died 15 days	General tuberculosis.
P. LIX.	Original material	21 days old, 6th generation	119 days	1496	2,370	1,610	Oct. 2, 1907	Died 20 days	General tuberculosis.
P. LX.	Original material	14 days old, 6th generation	118 days	1491	2,250	1,750	Oct. 1, 1907	Died 14 days	General tuberculosis.
P. LXI.	Original material	21 days old, 5th generation	101 days	1510	1,820	1,390	Oct. 8, 1907	Died 14 days	General tuberculosis.
P. LXII.	Original material	21 days old, 5th generation	107 days	1513	2,150	1,220	Oct. 14, 1907	Died 17 days	General tuberculosis.
P. LXIII.	Original material	24 days old, 4th generation	94 days	1522	2,050	1,500	Oct. 22, 1907	Died 17 days	General tuberculosis.

DOSE IN EACH CASE: 0.1 milligramme.

P. I.	Original material	21 days old, 8th generation	138 days	370	770	700	July 19th, 1905	Died 19 days	General tuberculosis.
P. V.	Original material	20 days old, 7th generation	134 days	397	1,200	920	Aug. 30th, 1905	Died 21 days	General tuberculosis.

P. VI.	Guinea-pig 1515	20 days old, 6th generation	126 days	403	1,870	1,370	Sept. 1st, 1905	Died 20 days	General tuberculosis.
P. VII.	Original material	20 days old, 8th generation	144 days	457	1,470	1,250	Sept. 18th, 1905	Died 22 days	General tuberculosis.
P. VIII.	Original material	20 days old, 5th generation	117 days	427	1,220	1,080	Sept. 5th, 1905	Died 18 days	General tuberculosis.
P. IX.	Original material	20 days old, 7th generation	125 days	469	1,350	1,040	Sept. 20th, 1905	Died 16 days	General tuberculosis.
P. X.	Original material	21 days old, 5th generation	116 days	448	1,250	970	Sept. 11th, 1905	Died 19 days	General tuberculosis.
P. XI.	Original material	20-5 days old, 4th generation	97 days	438	2,170	1,650	Sept. 6th, 1905	Died 19 days	General tuberculosis.
P. XII.	Guinea-pig 1636	20 days old, 5th generation	101 days	597	1,980	1,320	Dec. 14th, 1905	Died 19 days	General tuberculosis.
P. XIII.	Original material	21 days old, 6th generation	116 days	509	2,750	2,010	Oct. 31st, 1905	Died 21 days	General tuberculosis.
P. XIV.	Guinea-pig 1623	21 days old, 6th generation	139 days	694	1,240	900	Jan. 29th, 1906	Died 19 days	General tuberculosis.
P. XIV.	Original material.	21 days old, 21st generation	581 days	1307	1,900	1,100	April 16, 1907	Died 67 days	General tuberculosis.
P. XIV.	Original material.	21 days old, 23rd generation	672 days	1406	1,510	890	July 16, 1907	Died 45 days	General tuberculosis.
P. XV.	Original material	20 days old, 8th generation	114 days	533	1,330	1,250	Nov. 23rd, 1905	Died 13 days	Early general tuberculosis.
P. XVI.	Original material	20 days old, 5th generation	100 days	527	1,450	1,250	Nov. 22nd, 1905	Died 17 days	General tuberculosis.
P. XVII.	Original material	20 days old, 6th generation	123 days	610	1,360	1,060	Dec. 15th, 1905	Died 20 days	General tuberculosis.
P. XVIII.	Original material	20 days old, 6th generation	119 days	584	1,680	1,370	Dec. 11th, 1905	Died 20 days	General tuberculosis.
P. XIX.	Original material	20 days old, 6th generation	128 days	622	1,520	1,250	Dec. 20th, 1905	Died 21 days	General tuberculosis.
P. XX.	Original material	21 days old, 5th generation	85 days	779	1,190	900	Feb. 23rd, 1906	Died 15 days	General tuberculosis.
P. XXII.	Original material	21 days old, 4th generation	77 days	608	1,160	920	Dec. 14th, 1905	Died 7 days	No tuberculosis.
P. XXII.	Rabbit 483	20 days old, 5th generation	77 days	703	1,750	1,410	Feb. 2nd, 1906	Died 15 days	General tuberculosis.
P. XXIII.	Original material	21 days old, 6th generation	116 days	670	1,700	1,610	Jan. 22nd, 1906	Died 16 days	General tuberculosis.
P. XXIV.	Guinea-pig 1790	20 days old, 3rd generation	102 days	803	1,350	1,180	March 20th, 1906	Died 19 days	General tuberculosis.
P. XXV.	Original material	6 days old, 6th generation	76 days	780	1,050	740	Feb. 22nd, 1906	Died 15 days	General tuberculosis.
P. XXVI.	Original material	22 days old, 6th generation	126 days	826	1,140	900	April 18th, 1906	Died 13 days	General tuberculosis.
P. XXIX.	Original material	21 days old, 5th generation	114 days	820	1,710	1,250	April 13th, 1906	Died 17 days	General tuberculosis.
P. XXX.	Original material	19 days old, 6th generation	132 days	852	1,200	930	May 1st, 1906	Died 22 days	General tuberculosis.
P. XXXI.	Original material	20 days old, 6th generation	140 days	628	1,100	—	May 9th, 1906	Died 1 day	Death due to psorospermiosis of liver.
P. XXXII.	Original material	21 days old, 7th generation	143 days	966	1,760	1,080	July 5th, 1906	Died 18 days	General tuberculosis.

INTRAVENOUS INOCULATIONS OF RABBITS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN—*continued*.DOSE IN EACH CASE: 0.1 milligramme—*continued*.

Virus.	Source of Culture,	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
					Initial.	Final.			
P. XXXIII.	Original material	22 days old, 7th generation	140 days	976	1,370	950	July 5th, 1906	Died 20 days	General tuberculosis.
P. XXXIV.	Original material	22 days old, 7th generation	140 days	983	880	700	July 6th, 1906	Died 12 days	Early general tuberculosis.
P. XXXVL	Original material	21 days old, 10th generation	245 days	1094	3,260	2,200	Nov. 23rd, 1906	Died 26 days	General tuberculosis.
P. XXXVII.	Original material	21 days old, 10th generation	245 days	1100	2,900	2,150	Nov. 23rd, 1906	Died 21 days	General tuberculosis.
P. XXXVIII.	Original material	21 days old, 8th generation	193 days	1106	2,400	1,720	Nov. 24th, 1906	Died 11 days	Early general tuberculosis.
P. XXXIX.	Original material	14 days old, 10th generation	281 days	1251	1,900	1,430	Feb. 20th, 1907	Died 16 days	General tuberculosis.
P. XL.	Original material	21 days old, 8th generation	196 days	1117	2,200	1,450	Nov. 27th 1906	Died 25 days	General tuberculosis.
P. XLII.	Original material	21 days old, 8th generation	177 days	1071	1,200	1,000	Nov. 17th, 1906	Died 19 days	General tuberculosis.
P. XLIII.	Original material	21 days old, 6th generation	169 days	1127	2,320	1,960	Nov. 28th, 1906	Died 18 days	General tuberculosis.
P. XLVII.	Original material	21 days old, 8th generation	183 days	1143	1,600	—	Jan. 19th, 1907	Died 20 days	General tuberculosis.
P. XLIX.	Original material	21 days old, 6th generation	157 days	1202	1,600	1,120	Jan. 19th, 1907	Died 13 days	General tuberculosis.
P. L.	Original material	25 days old, 7th generation	141 days	1173	1,870	1,150	Jan. 3rd, 1907	Died 24 days	General tuberculosis.
P. XLI.	Original material	16 days old, 5th generation	95 days	1191	1,950	1,370	Jan. 18th, 1907	Died 16 days	General tuberculosis.
P. LII.	Original material	20 days old, 5th generation	95 days	1196	1,700	1,400	Jan. 18th, 1907	Died 18 days	General tuberculosis.
P. LIII.	Original material	21 days old, 8th generation	185 days	1396	2,170	1,150	July 15th, 1907	Died 23 days	General tuberculosis.
P. LIV.	Original material	21 days old, 7th generation	185 days	1398	1,520	1,100	July 15th, 1907	Died 19 days	General tuberculosis.
P. LV.	Original material	22 days old, 7th generation	186 days	1402	2,180	1,500	July 16th, 1907	Died 20 days	General tuberculosis.
P. LVI.	Original material	21 days old, 5th generation	143 days	1437	1,400	1,010	Sept. 9, 1907	Died 26 days	General tuberculosis.
P. LVI.	Original material	21 days old, 5th generation	143 days	1441	1,460	1,320	Sept. 9, 1907	Died 17 days	General tuberculosis.
P. LVII.	Original material	21 days old, 5th generation	117 days	1447	1,240	950	Sept. 10, 1907	Died 19 days	General tuberculosis.
	Original material			1449	1,310	980		Died 21 days	General tuberculosis.

INTRAPERITONEAL INOCULATIONS OF RABBITS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.

DOSE IN EACH CASE: 10 milligramme

P. LVIII.	Original material	21 days old, 6th generation	129 days	1498	2,050	1,400	Oct. 3, 1907	Died 22 days	General tuberculosis.
P. LIX.	Original material	21 days old, 6th generation	119 days	1494	1,240	890	Oct. 2, 1907	Died 21 days	General tuberculosis.
P. LX.	Original material	14 days old, 6th generation	118 days	1489	1,670	1,150	Oct. 1, 1907	Died 22 days	General tuberculosis.
P. LXI.	Original material	14 days old, 8th generation	121 days	1530	1,230	930	Oct. 28, 1907	Died 19 days	General tuberculosis.
P. LXII.	Original material	21 days old, 5th generation	107 days	1514	1,540	1,100	Oct. 14, 1907	Died 23 days	General tuberculosis.
P. LXIII.	Original material	24 days old, 4th generation	94 days	1520	1,470	1,170	Oct. 22, 1907	Died 18 days	General tuberculosis.

P. I.	Original material	21 days old, 8th generation	138 days	366	940	750	July 19th, 1905	Died 17 days	General tuberculosis.
P. V.	Original material	20 days old, 7th generation	134 days	367	810	660	Aug. 30th, 1905	Died 29 days	General tuberculosis.
P. VI.	Guinea-pig 1515	20 days old, 6th generation	126 days	394	2,730	1,470	Sept. 1st, 1905	Died 21 days	General tuberculosis.
P. VII.	Guinea-pig 1515	20 days old, 8th generation	144 days	399	1,000	800	Sept. 18th, 1905	Died 13 days	General tuberculosis.
P. VIII.	Original material	20 days old, 5th generation	117 days	401	3,745	2,590	Sept. 5th, 1905	Died 15 days	General tuberculosis.
P. IX.	Original material	20 days old, 7th generation	125 days	404	1,550	1,200	Sept. 20th, 1905	Died 20 days	General tuberculosis.
P. X.	Original material	21 days old, 5th generation	116 days	453	2,020	1,500	Sept. 11th, 1905	Died 57 days	General tuberculosis. Inoculation partly intra-caecal.
P. XI.	Original material	20.5 days old, 4th generation	97 days	456	1,590	1,400	Dec. 14th, 1905	Died 16 days	General tuberculosis.
P. XII.	Guinea-pig 1636	20 days old, 5th generation	101 days	424	1,850	1,370	Oct. 30th, 1905	Died 18 days	General tuberculosis.
P. XIII.	Original material	21 days old, 6th generation	116 days	466	1,520	1,250	Jan. 29th, 1906	Died 20 days	General tuberculosis.
P. XIV.	Guinea-pig 1623	21 days old, 6th generation	139 days	445	1,450	1,120	—	Died 10 days	Early general tuberculosis.
				446	1,170	820			
				436	2,070	1,720			
				598	1,670	1,250			
				507	2,850	2,250			
				695	1,280	—			

INTRAPERITONEAL INOCULATIONS OF RABBITS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN—*continued*.

DOSE IN EACH CASE: 10 milligramme—*continued*.

Virus.	Source of Culture.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
					Initial.	Final.			
P. XV.	Original material	20 days old, 8th generation	114 days	531	1,560	1,120	Nov. 23rd, 1905	Died 13 days	Early general tuberculosis.
P. XVI.	Original material	20 days old, 5th generation	100 days	525	1,330	1,060	Nov. 22nd, 1905	Died 14 days	Early general tuberculosis.
P. XVII.	Original material	20 days old, 6th generation	123 days	613	1,250	1,000	Dec. 15th, 1905	Died 18 days	General tuberculosis.
P. XVIII.	Original material	20 days old, 6th generation	119 days	585	1,520	1,130	Dec. 11th, 1905	Died 37 days	General tuberculosis, Inoculation partly intra-caecal.
P. XIX.	Original material	20 days old, 6th generation	123 days	619	1,920	1,310	Dec. 20th, 1905	Died 22 days	General tuberculosis.
P. XX.	Original material	21 days old, 5th generation	85 days	789	1,420	900	Feb. 23rd, 1906	Died 19 days	General tuberculosis.
P. XXII.	Original material	21 days old, 4th generation	77 days	609	1,170	1,640	Dec. 14th, 1905	Died 38 days	General tuberculosis, Inoculation partly subcutaneous.
	Rabbit 433	20 days old, 5th generation	77 days	707	1,980	1,370	Feb. 2nd, 1906	Died 15 days	General tuberculosis.
P. XXIII.	Original material	21 days old, 6th generation	116 days	668	2,000	1,570	Jan. 22nd, 1906	Died 21 days	General tuberculosis.
P. XXIV.	Guinea-pig 1790	20 days old, 3rd generation	102 days	807	1,550	1,130	March 20th, 1906	Died 18 days	General tuberculosis.
P. XXV.	Original material	6 days old, 6th generation	75 days	781	1,420	870	Feb. 22nd, 1906	Died 17 days	General tuberculosis.
P. XXVI.	Original material	22 days old, 6th generation	126 days	829	1,740	1,120	April 13th, 1906	Died 20 days	General tuberculosis.
P. XXIX.	Original material	21 days old, 5th generation	114 days	824	1,600	1,070	April 13th, 1906	Died 18 days	General tuberculosis.
P. XXX.	Original material	19 days old, 6th generation	132 days	853	1,780	1,300	May 1st, 1906	Died 24 days	General tuberculosis.
P. XXXI.	Original material	20 days old, 6th generation	140 days	863	1,900	1,170	May 9th, 1906	Died 17 days	General tuberculosis.
P. XXXII.	Original material	21 days old, 7th generation	143 days	969	1,540	—	July 5th, 1906	Died 8 days	Early generalized tuberculosis.
P. XXXIII.	Original material	22 days old, 7th generation	140 days	974	1,000	800	July 5th, 1906	Died 11 days	Early general tuberculosis.
P. XXXIV.	Original material	22 days old, 7th generation	140 days	979	1,510	1,050	July 6th, 1906	Died 15 days	General tuberculosis.
P. XXXVI.	Original material	21 days old, 10th generation	245 days	1096	950	700	Nov. 23rd, 1906	Died 19 days	General tuberculosis.
P. XXXVII.	Original material	22 days old, 10th generation	245 days	1101	2,200	1,800	Nov. 23rd, 1906	Died 10 days	Peritoneal tuberculosis. Death from cellulitis of the back.

P. XXXVIII.	Original material	21 days old, 8th generation	193 days	1107	2,600	1,900	Nov. 24th, 1906	Died 21 days	General tuberculosis.
P. XXXIX.	Original material	21 days old, 6th generation	196 days	1111	1,750	1,350	Nov. 27th, 1906	Died 41 days	General tuberculosis. Inoculation partly intra-caecal.
P. XXXIX.	Original material	14 days old, 10th generation	281 days	1253	1,450	1,070	Feb. 20th, 1907	Died 20 days	General tuberculosis.
P. XL.	Original material	21 days old, 8th generation	196 days	1122	2,200	1,750	Nov. 27th, 1906	Died 19 days	General tuberculosis.
P. XLII.	Original material	21 days old, 8th generation	177 days	1074	1,250	1,080	Nov. 17th, 1906	Died 18 days	General tuberculosis.
P. XLIII.	Original material	21 days old, 6th generation	169 days	1128	2,150	1,750	Nov. 28th, 1906	Died 8 days	Early general tuberculosis.
P. XLVII.	Original material	21 days old, 8th generation	183 days	1140	1,550	1,360	Dec. 4th, 1906	Died 20 days	General tuberculosis.
P. XLIX.	Original material	21 days old, 6th generation	187 days	1205	1,600	—	Jan. 19th, 1907	Died 56 days	General tuberculosis. Inoculation partly intra-caecal.
P. L.	Original material	25 days old, 7th generation	141 days	1176	1,700	1,400	Jan. 3rd, 1907	Died 16 days	General tuberculosis.
P. LI.	Original material	16 days old, 5th generation	95 days	1192	2,070	1,520	Jan. 18th, 1907	Died 16 days	General tuberculosis.
P. LII.	Original material	20 days old, 5th generation	95 days	1199	2,070	1,670	Jan. 18th, 1907	Died 9 days	Early general tuberculosis.

DOSE IN EACH CASE : 0·1 milligramme.

P. I.	Original material	21 days old, 8th generation	138 days	369	810	620	July 19th, 1905	Died 29 days	General tuberculosis.
P. V.	Original material	20 days old, 7th generation	134 days	398	1,020	700	Aug. 30th, 1905	Died 29 days	General tuberculosis.
P. VI.	Guinea-pig 1,515	20 days old, 6th generation	126 days	405	1,320	1,070	Sept. 1st, 1905	Died 33 days	General tuberculosis.
P. VII.	Original material	20 days old, 8th generation	144 days	{	1,690	1,300	{	Died 26 days	General tuberculosis.
	Original material				820	700		Died 19 days	General tuberculosis.
P. VIII.	Original material	20 days old, 5th generation	117 days	426	1,420	1,500	Sept. 5th, 1905	Died 27 days	General tuberculosis.
P. IX.	Original material	20 days old, 7th generation	125 days	468	1,400	1,200	Sept. 20th, 1905	Died 30 days	General tuberculosis.
P. X.	Original material	21 days old, 5th generation	116 days	449	1,330	970	Sept. 11th, 1905	Died 25 days	General tuberculosis.
P. XI.	Original material	{	97 days	{	1,350	1,020	{	Died 23 days	General tuberculosis.
	Original material				1,600	1,620		Died 27 days	General tuberculosis.
P. XII.	Guinea-pig 1,636	20 days old, 5th generation	101 days	600	1,440	1,250	Dec. 14th, 1905	Died 18 days	General tuberculosis.
P. XIII.	Original material	21 days old, 6th generation	116 days	505	2,300	1,650	Oct. 30th, 1905	Died 29 days	General tuberculosis.

INTRAPERITONEAL INOCULATIONS OF RABBITS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN—continued.

DOSE IN EACH CASE: 01 milligramme—continued.

Virus.	Source of Culture.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
					Initial.	Final.			
P. XIV.	Guinea-pig 1,623	21 days old, 6th generation	139 days	699	1,810	1,290	Jan. 29th, 1906	Died 19 days	General tuberculosis.
P. XV.	Original material	20 days old, 8th generation	114 days	529	1,550	1,070	Nov. 23rd, 1905	Died 20 days	General tuberculosis.
P. XVI.	Original material	20 days old, 5th generation	100 days	523	1,530	920	Nov. 22nd, 1905	Died 21 days	General tuberculosis.
P. XVII.	Original material	20 days old, 6th generation	123 days	615	1,170	970	Dec. 15th, 1905	Died 19 days	General tuberculosis.
P. XVIII.	Original material	20 days old, 6th generation	119 days	582	1,360	1,360	Dec. 11th, 1905	Died 13 days	Early general tuberculosis.
P. XIX.	Original material	20 days old, 6th generation	128 days	623	1,400	1,180	Dec. 20th, 1905	Died 19 days	General tuberculosis.
P. XX.	Original material	21 days old, 5th generation	85 days	786	1,050	710	Feb. 23rd, 1906	Died 20 days	General tuberculosis.
P. XXII.	Original material	21 days old, 4th generation	77 days	606	1,010	850	Dec. 14th, 1905	Died 6 days	No visible tuberculosis.
	Rabbit 483	20 days old, 5th generation	77 days	706	1,760	1,500	Feb. 2nd, 1906	Died 24 days	General tuberculosis.
P. XXIII.	Original material	21 days old, 6th generation	116 days	671	1,560	1,280	Jan. 23rd, 1906	Died 29 days	General tuberculosis.
P. XXIV.	Guinea-pig 1790	20 days old, 3rd generation	102 days	804	1,100	780	March 20th, 1906	Died 30 days	General tuberculosis.
P. XXVI.	Original material	22 days old, 6th generation	126 days	830	1,400	920	April 13th, 1906	Died 22 days	General tuberculosis.
P. XXIX.	Original material	21 days old, 5th generation	114 days	825	1,400	850	April 13th, 1906	Died 29 days	General tuberculosis.
P. XXX.	Original material	19 days old, 6th generation	132 days	854	1,220	1,090	May 1st, 1906	Died 17 days	General tuberculosis.
P. XXXI.	Original material	20 days old, 6th generation	140 days	864	1,600	980	May 9th, 1906	Died 28 days	General tuberculosis.
P. XXXII.	Original material	21 days old, 7th generation	143 days	967	1,800	1,210	July 5th, 1906	Died 27 days	General tuberculosis.
P. XXXIII.	Original material	22 days old, 7th generation	140 days	977	1,440	920	July 5th, 1906	Died 27 days	General tuberculosis.
P. XXXIV.	Original material	22 days old, 7th generation	140 days	980	1,100	770	July 6th, 1906	Died 23 days	General tuberculosis.
P. XXXVI.	Original material	21 days old, 10th generation	245 days	1095	920	800	Nov. 23rd, 1906	Died 35 days	General tuberculosis.
P. XXXVII.	Original material	21 days old, 10th generation	245 days	1102	880	800	Nov. 23rd, 1906	Died 48 days	General tuberculosis.
P. XXXVIII.	Original material	21 days old, 8th generation	193 days	1108	2,470	1,450	Nov. 24th, 1906	Died 23 days	General tuberculosis.

P. XXXIX.	Original material	21 days old, 6th generation	196 days	1113	1,700	1,300	Nov. 27th, 1906	Died 30 days	General tuberculosis.
P. XL.	Original material	21 days old, 8th generation	196 days	1121	2,020	1,300	Nov. 27th, 1906	Died 53 days	General tuberculosis.
P. XLII.	Original material	21 days old, 8th generation	177 days	1073	700	800	Nov. 17th, 1906	Died 46 days	General tuberculosis.
P. XLIII.	Original material	21 days old, 6th generation	169 days	1130	1,350	1,270	Nov. 28th, 1906	Died 60 days	General tuberculosis. Inoculation partly intra-caecal.
P. XLVII.	Original material	21 days old, 8th generation	183 days	1139	1,340	1,250	Dec. 4th, 1906	Died 25 days	General tuberculosis.
P. XLIX.	Original material	21 days old, 6th generation	157 days	1204	1,100	740	Jan. 19th, 1907	Died 48 days	General tuberculosis.
P. L.	Original material	25 days old, 7th generation	141 days	1175	1,120	950	Jan. 3rd, 1907	Died 40 days	General tuberculosis.
P. LI.	Original material	16 days old, 5th generation	95 days	1193	2,100	1,420	Jan. 18th, 1907	Died 32 days	General tuberculosis.
P. LII.	Original material	20 days old, 5th generation	95 days	1198	2,100	1,700	Jan. 18th, 1907	Died 25 days	General tuberculosis.

Dose in each case : 0·01 milligramme.

P. I.	Original material	21 days old, 8th generation	138 days	371	800	720	July 19th, 1905	Died 27 days	General tuberculosis.
P. V.	Original material	20 days old, 7th generation	134 days	400	850	640	Aug. 30th, 1905	Died 30 days	General tuberculosis.
P. VI.	Guinea-pig 1515	20 days old, 6th generation	126 days	407	1,190	890	Sept. 1st, 1905	Died 36 days	General tuberculosis.
P. VII.	Original material	20 days old, 8th generation	144 days	459	1,240	950	Sept. 18th, 1905	Died 25 days	General tuberculosis.
P. VIII.	Original material	20 days old, 5th generation	117 days	429	1,080	920	Sept. 5th, 1905	Died 32 days	General tuberculosis.
P. X.	Original material	21 days old, 5th generation	116 days	451	1,030	900	Sept. 11th, 1905	Died 47 days	General tuberculosis.
P. XI.	Original material	20·5 days old, 4th generation	97 days	442	1,070	820	Sept. 6th, 1905	Died 29 days	General tuberculosis.
P. XII.	Guinea-pig 1636	20 days old, 5th generation	101 days	602	1,010	900	Dec. 14th, 1905	Died 75 days	General tuberculosis. Inoculation partly subcutaneous.
P. XIII.	Original material	21 days old, 6th generation	116 days	508	1,950	1,450	Oct. 30th, 1905	Died 33 days	General tuberculosis.
P. XIV.	Guinea-pig 1623	21 days old, 6th generation	139 days	696	810	630	Jan. 29th, 1906	Died 9 days	Death from psorospermiosis of liver.
P. XV.	Original material	20 days old, 8th generation	114 days	532	1,740	1,280	Nov. 23rd, 1905	Died 28 days	General tuberculosis.
P. XVI.	Original material	20 days old, 5th generation	100 days	526	1,590	1,150	Nov. 22nd, 1905	Died 38 days	General tuberculosis.
P. XVII.	Original material	20 days old, 6th generation	123 days	611	1,090	820	Dec. 15th, 1905	Died 52 days	General tuberculosis.
P. XVIII.	Original material	20 days old, 6th generation	119 days	583	1,220	1,000	Dec. 11th, 1905	Died 23 days	General tuberculosis.
P. XIX.	Original material	20 days old, 6th generation	128 days	620	1,250	870	Dec. 20th, 1905	Died 41 days	General tuberculosis.

SUBCUTANEOUS INOCULATIONS OF RABBITS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.

DOSE IN EACH CASE: 10'0 milligrammes.

Virus.	Source of Culture.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
					Initial.	Final.			
P. IX.	Original material	20 days old, 7th generation	125 days	465	1,250	1,020	Sept. 20th, 1905	Died 28 days	General tuberculosis.
P. XIV.	Original material	21 days old, 21st generation	581 days	1292	1,300	1,180	April 16, 1907	Died 99 days	General tuberculosis.
P. XIV.	Original material	21 days old, 23rd generation	672 days	1409	1,770	1,990	July 16, 1907	Died 201 days	General tuberculosis.
P. XXXVII.	Original material	21 days old, 10th generation	245 days	1104	760	800	Nov. 23rd, 1906	Died 31 days	General tuberculosis.
P. XXXVIII.	Original material	21 days old, 8th generation	193 days	1109	2,250	1,850	Nov. 24th, 1906	Died 87 days	General tuberculosis.
P. XXXIX.	Original material	21 days old, 6th generation	196 days	1114	1,290	1,100	Nov. 27th, 1906	Died 63 days	General tuberculosis.
P. XL.	Original material	21 days old, 8th generation	196 days	1118	1,910	1,240	Nov. 27th, 1906	Died 77 days	General tuberculosis.
P. XLII.	Original material	21 days old, 8th generation	177 days	1070	1,550	1,200	Nov. 17th, 1906	Died 51 days	General tuberculosis.
P. XLIX.	Original material	21 days old, 6th generation	157 days	1206	2,200	1,640	Jan. 18th, 1907	Died 40 days	General tuberculosis.
P. L.	Original material	25 days old, 7th generation	141 days	1178	1,620	1,100	Jan. 3rd, 1907	Died 77 days	General tuberculosis.
P. LIII.	Original material	21 days old, 8th generation	185 days	1395	2,200	1,550	July 15th, 1907	Died 32 days	General tuberculosis.
P. LIV.	Original material	21 days old, 7th generation	185 days	1401	1,870	1,270	July 15th, 1907	Died 54 days	General tuberculosis.
P. LV.	Original material	22 days old, 7th generation	186 days	1405	2,440	1,680	July 16th, 1907	Died 44 days	General tuberculosis.
P. LVI.	Original material	21 days old, 5th generation	143 days	1439	1,800	1,390	Sept. 9th, 1907	Died 55 days	General tuberculosis.
P. LVII.	Original material	21 days old, 5th generation	117 days	1450	1,810	1,370	Sept. 10th, 1907	Died 64 days	General tuberculosis.
P. LVIII.	Original material	21 days old, 6th generation	129 days	1497	2,470	1,990	Oct. 3, 1907	Died 29 days	General tuberculosis.
P. LIX.	Original material	21 days old, 6th generation	119 days	1495	2,130	1,800	Oct. 2, 1907	Died 38 days	General tuberculosis.
P. LX.	Original material	14 days old, 6th generation	118 days	1492	2,200	1,350	Oct. 1, 1907	Died 101 days	General tuberculosis.
P. LXII.	Original material	21 days old, 5th generation	107 days	1515	2,240	1,850	Oct. 14, 1907	Died 63 days	General tuberculosis.
P. LXIII.	Original material	24 days old, 4th generation	94 days	1521	1,840	1,320	Oct. 22, 1907	Died 34 days	General tuberculosis.

P. I.	Original material	21 days old, 8th generation	138 days	365	780	920	July 19th, 1905	Died 73 days	General tuberculosis.
P. V.	Original material	20 days old, 7th generation	134 days	395	1,800	1,210	Aug. 30th, 1905	Died 88 days	General tuberculosis.
P. VI.	Guinea-pig 1515	20 days old, 6th generation	126 days	402	1,700	1,300	Sept. 1st, 1905	Died 71 days	General tuberculosis.
P. VII.	Original material	20 days old, 8th generation	144 days	454	1,650	1,380	Sept. 18th, 1905	Died 61 days	General tuberculosis.
P. VIII.	Original material	20 days old, 5th generation	117 days	425	1,420	1,520	Sept. 5th, 1905	Died 62 days	General tuberculosis.
P. IX.	Original material	20 days old, 7th generation	125 days	467	1,450	1,300	Sept. 20th, 1905	Died 51 days	General tuberculosis.
P. X.	Original material	21 days old, 5th generation	116 days	447	1,250	1,370	Sept. 11th, 1905	Died 84 days	General tuberculosis.
P. XI.	Original material	20·5 days old, 4th generation	97 days	437	2,120	1,590	Sept. 6th, 1905	Died 120 days	General tuberculosis.
P. XII.	Guinea-pig 1636	20 days old, 5th generation	101 days	599	1,400	1,150	Dec. 14th, 1905	Died 97 days	General tuberculosis.
P. XIV.	Guinea-pig 1623	21 days old, 6th generation	129 days	697	1,350	870	Jan. 29th, 1906	Died 16 days	Small local lesion and caseous foci in the nearest glands only.
P. XIV.	Original material	12 days old, 21st generation	581 days	1308	2,220	1,420	April 16, 1907	Died 72 days	General tuberculosis.
P. XIV.	Original material	21 days old, 23rd generation	672 days	1408	1,300	1,320	July 16, 1907	Died 177 days	General tuberculosis.
P. XVII.	Original material	20 days old, 6th generation	123 days	616	1,250	1,000	Dec. 15th, 1905	Died 165 days	General tuberculosis.
P. XVIII.	Original material	20 days old, 6th generation	119 days	588	1,450	1,120	Dec. 11th, 1905	Died 79 days	General tuberculosis.
P. XIX.	Original material	20 days old, 6th generation	128 days	621	1,440	1,020	Dec. 20th, 1905	Died 57 days	General tuberculosis.
P. XX.	Original material	21 days old, 5th generation	85 days	788	1,200	700	Feb. 23rd, 1906	Died 73 days	General tuberculosis.
P. XXII.	Original material	21 days old, 4th generation	77 days	604	1,040	1,150	Dec. 14th, 1905	Died 52 days	General tuberculosis.
P. XXIII.	Original material	21 days old, 6th generation	116 days	669	1,040	750	Jan. 23rd, 1906	Died 54 days	General tuberculosis.
P. XXIV.	Guinea-pig 1790	20 days old, 3rd generation	102 days	806	1,450	870	Mar. 20th, 1906	Died 86 days	General tuberculosis.
P. XXV.	Original material	6 days old, 6th generation	75 days	782	1,160	800	{ Feb. 22nd, 1906 }	Died 20 days	Caseous local lesion, opaque foci in the nearest glands, and one focus in the spleen.
P. XXVI.	Original material	22 days old, 6th generation	126 days	783	1,180	770		Died 70 days	General tuberculosis.
P. XXIX.	Original material	21 days old, 5th generation	114 days	821	1,370	2,280	April 13th, 1906	Killed 136 days	Chronic generalized tuberculosis.
P. XXX.	Original material	19 days old, 6th generation	132 days	855	1,600	930	April 13th, 1906	Died 75 days	General tuberculosis.
P. XXXI.	Original material	20 days old, 6th generation	140 days	865	1,700	1,020	May 1st, 1906	Died 57 days	General tuberculosis.
						980	May 9th, 1906	Died 70 days	General tuberculosis.

SUBCUTANEOUS INOCULATIONS OF RABBITS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN—continued.
DOSE IN EACH CASE: 1.0 milligramme—continued.

Virus.	Source of Culture.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
					Initial.	Final.			
P. XXXII.	Original material	21 days old, 7th generation	143 days	970	1,600	1,850	July 5th, 1906	Died 97 days	General tuberculosis.
P. XXXIII.	Original material	22 days old, 7th generation	140 days	975	1,100	1,100	July 5th, 1906	Died 94 days	General tuberculosis.
P. XXXIV.	Original material	22 days old, 7th generation	140 days	982	1,150	1,160	July 6th, 1906	Died 72 days	General tuberculosis.
P. XXXVI.	Original material	21 days old, 10th generation	245 days	1098	730	900	Nov. 23rd, 1906	Died 75 days	General tuberculosis.
P. XXXVII.	Original material	21 days old, 10th generation	245 days	1103	580	820	Nov. 23rd, 1906	Died 64 days	General tuberculosis.
P. XXXVIII.	Original material	21 days old, 8th generation	193 days	1110	2,400	--	Nov. 24th, 1906	Died 75 days	General tuberculosis.
P. XXXIX.	Original material	21 days old, 6th generation	196 days	1112	1,190	1,260	Nov. 27th, 1906	Died 75 days	General tuberculosis.
P. XL.	Original material	21 days old, 8th generation	196 days	1119	1,760	1,520	Nov. 27th, 1906	Died 69 days	General tuberculosis.
P. XLII.	Original material	21 days old, 8th generation	177 days	1069	1,600	1,400	Nov. 17th, 1906	Died 49 days	General tuberculosis.
P. XLVII.	Original material	21 days old, 8th generation	183 days	1142	1,120	1,100	Dec. 4th, 1906	Died 86 days	General tuberculosis.
P. XLIX.	Original material	21 days old, 6th generation	157 days	1207	1,350	1,200	Jan. 19th, 1907	Died 40 days	General tuberculosis.
P. L.	Original material	25 days old, 7th generation	141 days	1177	1,920	1,380	Jan. 3rd, 1907	Died 67 days	General tuberculosis.
P. LI.	Original material	16 days old, 5th generation	95 days	1195	1,700	1,400	Jan. 18th, 1907	Died 56 days	General tuberculosis.
P. LII.	Original material	20 days old, 5th generation	95 days	{ 1200	1,900	1,720	{ Jan. 18th, 1907	Died 46 days	General tuberculosis.
	Original material				2,850	1,900		Died 69 days	General tuberculosis.
P. LIII.	Original material	21 days old, 8th generation	185 days	1394	2,650	2,000	July 15th, 1907	Died 29 days	General tuberculosis, acute, In- oculation intra-muscular.
P. LIV.	Original material	21 days old, 7th generation	185 days	1400	1,870	1,510	July 15th, 1907	Died 53 days	General tuberculosis.
P. LV.	Original material	22 days old, 7th generation	186 days	1404	2,240	1,780	July 16th, 1907	Died 58 days	General tuberculosis.
P. LVI.	Original material	21 days old, 5th generation	143 days	1438	1,640	1,650	Sept. 9th, 1907	Died 33 days	General tuberculosis.
P. LVII.	Original material	21 days old, 5th generation	117 days	1451	1,390	1,420	Sept. 10th, 1907	Died 46 days	General tuberculosis.
P. LVIII.	Original material	21 days old, 6th generation	129 days	1499	2,460	1,680	Oct. 3rd, 1907	Died 48 days	General tuberculosis.
P. LIX.	Original material	21 days old, 6th generation	119 days	1493	1,820	1,220	Oct. 2nd, 1907	Died 71 days	General tuberculosis.

P. LX.	Original material	14 days old, 6th generation	118 days	1490	1,670	1,110	Oct. 1st, 1907	Died 72 days	General tuberculosis.
P. LXI.	Original material	14 days old, 8th generation	121 days	1528	1,500	1,300	{ Oct 28th, 1907	Died 58 days	General tuberculosis.
				1529	1,620	1,100		Died 50 days	General tuberculosis.
P. LXII.	Original material	21 days old, 5th generation	107 days	1512	2,000	1,520	Oct. 14th, 1907	Died 63 days	General tuberculosis.
P. LXIII.	Original material	24 days old, 4th generation	94 days	1523	1,780	1,600	Oct. 22nd, 1907	Died 66 days	General tuberculosis.

DOSE IN EACH CASE: 0.1 milligramme.									
P. I.	Original material	21 days old, 8th generation	138 days	368	790	920	July 19th, 1905	Died 74 days	General tuberculosis.
P. V.	Original material	20 days old, 5th generation	134 days	396	1,400	1,550	Aug. 30th, 1905	Died 58 days	General tuberculosis.
P. VI.	Guinea-pig 1,515	20 days old, 6th generation	126 days	406	1,270	1,250	Sept. 1st, 1905	Died 88 days	General tuberculosis.
P. VII.	Original material	20 days old, 8th generation	144 days	458	1,220	1,540	Sept. 18th, 1905	Died 36 days	Early general tuberculosis, death due to enteritis.
P. VIII.	Original material	20 days old, 5th generation	117 days	428	1,060	950	Sept. 5th, 1905	Died 87 days	General tuberculosis.
P. IX.	Original material	20 days old, 7th generation	125 days	470	1,370	1,000	Sept. 20th, 1905	Died 89 days	General tuberculosis.
P. X.	Original material	21 days old, 5th generation	116 days	450	1,140	1,100	Sept. 11th, 1905	Died 88 days	General tuberculosis.
P. XI.	Original material	20.5 days old, 4th generation	97 days	441	1,170	950	Sept. 6th, 1905	Died 62 days	General tuberculosis.
P. XII.	Guinea-pig 1,636	20 days old, 5th generation	101 days	603	1,200	1,050	Dec. 14th, 1905	Died 105 days	General tuberculosis.
P. XIII.	Original material	21 days old, 6th generation	116 days	510	2,100	1,600	Oct. 30th, 1905	Died 53 days	General tuberculosis.
P. XV.	Original material	20 days old, 8th generation	114 days	534	1,720	1,900	Nov. 23rd, 1905	Died 39 days	Early general tuberculosis, death due to septic peritonitis.
P. XVI.	Original material	20 days old, 5th generation	100 days	528	1,680	1,180	Nov. 22nd, 1905	Died 102 days	General tuberculosis.
P. XVII.	Original material	20 days old, 6th generation	123 days	614	1,020	1,100	Dec. 15th, 1905	Died 100 days	General tuberculosis.
P. XVIII.	Original material	20 days old, 6th generation	119 days	587	1,390	1,080	Dec. 11th, 1905	Died 93 days	General tuberculosis.
P. XIX.	Original material	20 days old, 6th generation	128 days	624	1,440	1,120	Dec. 20th, 1905	Died 82 days	General tuberculosis.
P. XX.	Original material	21 days old, 5th generation	85 days	785	900	650	Feb. 23rd, 1906	Died 33 days	Early general tuberculosis, ? cause of death.
P. XXII.	Original material	21 days old, 4th generation	77 days	605	960	920	Dec. 14th, 1905	Died 133 days	General tuberculosis.
P. XXIII.	Rabbit 483	20 days old, 5th generation	77 days	704	1,230	1,100	Feb. 2nd, 1906	Died 33 days	Early general tuberculosis. Psorospormosis of liver.
	Original material	21 days old, 6th generation	116 days	672	1,240	1,100	Jan. 22nd, 1906	Died 87 days	General tuberculosis.

SUBCUTANEOUS INOCULATIONS OF RABBITS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN—*continued*.DOSE IN EACH CASE : 0.1 milligramme—*continued*.

Virus.	Source of Culture.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
					Initial.	Final.			
P. XXIV.	Guinea-pig 1,790	20 days old, 3rd generation	102 days	808	870	840	March 20th, 1906	Died 74 days	General tuberculosis.
P. XXV.	Original material	6 days old, 6th generation	75 days	784	1,020	870	Feb. 22nd, 1906	Died 56 days	General tuberculosis.
P. XXVI.	Original material	22 days old, 6th generation	126 days	827	1,370	1,440	April 13th, 1906	Died 90 days	General tuberculosis.
P. XXIX.	Original material	21 days old, 5th generation	114 days	822	1,300	1,060	April 13th, 1906	Died 126 days	General tuberculosis.
P. XXX.	Original material	19 days old, 6th generation	132 days	856	1,560	1,120	May 1st, 1906	Died 55 days	General tuberculosis.
P. XXXI.	Original material	20 days old, 6th generation	140 days	866	1,100	820	May 9th, 1906	Died 74 days	General tuberculosis.
P. XXXII.	Original material	21 days old, 7th generation	143 days	968	1,520	1,150	July 5th, 1906	Died 98 days	General tuberculosis.
P. XXXIV.	Original material	22 days old, 7th generation	140 days	981	1,070	1,050	July 6th, 1906	Died 146 days	General tuberculosis.
P. XXXVI.	Original material	21 days old, 10th generation	245 days	1097	720	760	Nov. 23rd, 1906	Died 69 days	General tuberculosis.

DOSE IN EACH CASE : 0.01 milligramme.

P. XII.	Guinea-pig 1,636	20 days old, 5th generation	101 days	601	1,140	900	Dec. 14th, 1905	Died 89 days	General tuberculosis.
P. XIII.	Original material	21 days old, 6th generation	116 days	506	1,320	1,490	Oct. 30th, 1905	Died 69 days	General tuberculosis.
P. XIV.	Original material	21 days old, 12th generation	290 days	698	850	700	June 29, 1906	Died 58 days	General tuberculosis.
P. XV.	Original material	20 days old, 8th generation	114 days	530	1,180	1,270	Nov. 23rd, 1905	Died 46 days	Early general tuberculosis ; death due to enteritis.
P. XVI.	Original material	20 days old, 5th generation	100 days	524	1,340	1,190	Nov. 22nd, 1905	Died 70 days	General tuberculosis.
P. XVII.	Original material	20 days old, 6th generation	123 days	612	1,090	890	Dec. 15th, 1905	Died 74 days	General tuberculosis.
P. XVIII.	Original material	20 days old, 6th generation	119 days	586	1,230	1,070	Dec. 11th, 1905	Died 125 days	General tuberculosis.
P. XIX.	Original material	20 days old, 6th generation	128 days	625	1,090	880	Dec. 20th, 1905	Died 91 days	General tuberculosis

P. XX.	Original material	21 days old, 5th generation	85 days	787	1,100	890	Feb. 23rd, 1906	Died 28 days	Caseous local tumour, a few foci in the nearest glands, and one tubercle in the lung.
P. XXII.	Rabbit 483	20 days old, 5th generation	77 days	705	1,050	870	Feb. 2nd, 1906	Died 88 days	General tuberculosis.
P. XXIII.	Original material	21 days old, 6th generation	116 days	673	990	1,040	Jan. 22nd, 1906	Died 122 days	General tuberculosis.
P. XXIV.	Guinea-pig 1,790	20 days old, 3rd generation	102 days	805	970	760	Mar. 20th, 1906	Died 107 days	General tuberculosis.
P. XXVI.	Original material	22 days old, 6th generation	126 days	828	1,300	740	Apr. 13th, 1906	Died 77 days	General tuberculosis.
P. XXIX.	Original material	21 days old, 5th generation	114 days	823	1,230	850	Apr. 13th, 1906	Died 80 days	General tuberculosis.

INTRAVENOUS INOCULATIONS OF RABBITS WITH CULTURES OF SLIGHTLY VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.

Virus.	Source of Culture.	Dose.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
						Initial.	Final.			
P. IV.	Original material.	0.1 mg.	20 days old, 5th generation.	76 days	307	1,690	1,960	June 5th, 1905	Killed 86 days.	The lungs contained scattered tubercles up to a millet seed with opaque caseous centres; there were confluent tubercles in the ventral margins and caseous patches on the dorsal surfaces of the caudal lobes. A yellow focus was seen in one bronchial gland; on the surfaces of the kidneys there were discrete tubercles with grey margins and caseous centres which extended as radial streaks through the pyramids. Other organs and glands normal. The margins of the lungs were caseous and almost the whole of the dorsal surface of the left caudal lobe was covered with a caseous patch 5 mm. in greatest thickness. The kidneys were similar in appearance to those of Rabbit 307; radial section showed several broad streaks extending from cortex through the medulla. The lungs contained fairly numerous nodules varying from a pinhead up to 3 mm. in diameter; they were firm, grey, projecting, and the largest were almost entirely caseous and slightly gritty. On the dorsal surface of the left caudal lobe extending almost the whole length and 1 cm. in width there was a firm grey nodule speckled with yellow gritty foci, and a smaller similar nodule was seen in the left. The cephalic lobes were almost replaced by firm grey nodules. There was a soft caseous tubercle in a bronchial gland. The kidneys showed on the surfaces scattered round nodules up to 2 mm. in diameter; the centres were composed of soft caseous substance which extended as streaks through the pyramids. Other organs and glands normal.
P. IV.	Original material.	1.0 mg.	20 days old, 5th generation.	76 days	308	1,850	1,640	June 5th, 1905	Killed 87 days.	
P. IV.	Original material.	1.0 mg.	21 days old, 11th generation.	183 days	461	1,970	1,940	September 20th, 1905.	Killed 90 days.	

INTRAVENOUS INOCULATIONS OF RABBITS WITH CULTURES OF SLIGHTLY VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN—*continued*.

Virus.	Source of Culture.	Dose.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
						Initial.	Final.			
P. XII.	Original material.	0.1 mg.	21 days old, 8th generation.	175 days	1051	2,150	2,400	November 15th, 1906.	Killed 99 days.	Spleen normal; in the cortex of each kidney there were three grey miliary tubercles with soft caseous centres, and a soft caseous streak was seen in the medulla of one kidney. The lungs were crepitant and contained sparsely scattered minute translucent tubercles, a few opaque in the centre. In the left testis there was a soft caseous nodule which contained numerous tubercle bacilli. Other organs and the lymphatic glands were normal.
P. XII.	Original material.	1.0 mg.	21 days old, 8th generation.	175 days	1052	1,950	1,600	November 15th, 1906.	Died 11 days.	No visible tuberculosis; tubercle bacilli found in smear preparations of lung, liver, and spleen.
P. XII.	Lung of Pig 166.	0.1 mg.	20 days old, 7th generation.	136 days	1479	1,130	2,770	September 20th, 1907.	Killed 129 days.	In the lungs which were pink and crepitant, there were a few caseous tubercles and reddish grey marginal nodules. Each kidney showed on the surface a reddish grey depressed patch beset with caseous foci, and on section there was a soft caseous streak passing from it through the pyramids. No disease elsewhere.
P. XII.	Lung of Pig 166.	1.0 mg.	20 days old, 7th generation.	136 days	1481	1,200	1,160	September 20th, 1907.	Killed 129 days.	In the lung just beneath the pleura, there were a few minute caseous tubercles. The kidneys showed a few grey nodules with soft yellow centres in the cortices and several streaks in the pyramids. No disease elsewhere.
P. XII.	Lung of Pig 258.	0.01 mg.	21 days old, 2nd generation.	35 days	1861	800	1,100	July 28th, 1908	Killed 100 days.	The caudal lobes of the lungs contained grey nodules beset with yellow caseous foci. In the kidneys there were one or two cascating submiliary tubercles. No disease elsewhere.
P. XII.	Lung of Pig 258.	0.1 mg.	21 days old, 2nd generation.	35 days	1862	1,000	1,770	July 28th, 1908	Killed 101 days.	The lungs showed sparsely scattered translucent foci and two caseous gritty patches at one caudal extremity. A few opaque foci in the liver and spleen. The pyramids of the kidneys contained several grey tubercles and soft caseous streaks.
P. XII.	Lung of Pig 258.	1.0 mg.	21 days old, 2nd generation.	35 days	1863	850	620	July 28th, 1908	Died 27 days.	The lungs were congested and oedematous, and the substance was beset with indefinite grey tubercles, with a few opaque points. Spleen swollen. A few grey points on the liver. The cortices of the kidneys were filled with ill-defined grey foci. Caseous foci in the bronchial and portal glands.
P. XLVI.	Original material.	0.1 mg.	21 days old, 7th generation.	136 days	1046	2,600	2,650	November 15th, 1906.	Killed 100 days.	In the spleen there was one opaque focus. Kidneys contained a few grey tubercles with caseous centres in the cortices and caseous streaks in the pyramids; the pelvis of the left kidney was filled with muco-pus. On the surface of the lungs there were scattered grey nodules with soft caseous centres up to a wheat grain. Caseous focus in a mediastinal gland. No tuberculosis elsewhere.
P. XLVI.	Original material.	1.0 mg.	21 days old, 7th generation.	136 days	1045	2,950	2,900	November 15th, 1906	Killed 100 days.	Spleen showed a few grey foci; in the cortices of the kidneys there were a few grey tubercles up to a millet seed with opaque centres. Lungs pink and crepitant contained a few translucent tubercles and one marginal grey nodule with softening caseous centre. There were caseous foci in the mammary gland beneath each nipple in which were moderately numerous tubercle bacilli. No disease elsewhere.

P. IV.	Original material.	1.0 mg.	20 days old, 5th generation.	76 days	314	790	1,300	June 5th, 1905	Died 333 days.	In the omentum and on the peritoneum there were slightly gritty caseo-purulent nodules. Spleen normal. The surfaces of the kidneys were pitted, and showed numerous grey tubercles up to 3 mm. in diameter with caseous centres. On the pleural surface of the diaphragm there was a thick mass of firm fibro-caseous nodules, and also large caseous nodules on the pericardium and between the heart and diaphragm. The lungs filled the pleural cavities; the right-posterior lobe consisted of a caseo-purulent cyst, and there were three similar cysts up to the size of a pigeon's egg in the left lung; the rest of the substance was filled with caseous nodules with confluent grey margins, leaving very little lung tissue. Flattened caseous masses on the parietal pleura; caseous nodules in mediastinal and axillary glands; and opaque foci in the mesenteric. A small tubercle in the left thyroid lobe.
P. IV.	Original material.	1.0 mg.	20 days old, 5th generation.	76 days	312	1,540	2,350	June 5th, 1905	Killed 91 days.	Caseo-purulent nodule in the subcutaneous tissue, and a caseous focus in each of the nearest glands. Pinhead-sized tubercles in the omentum. The lungs were crepitant, and contained moderately numerous hard grey tubercles up to 3 mm. in diameter with softened caseous centres. Other organs and glands normal.
P. IV.	Original material.	1.0 mg.	21 days old, 11th generation.	183 days	462	1,770	1,950	September 20th, 1905.	Killed 90 days.	In the omentum there were moderately numerous pinhead-sized tubercles; on the peritoneum there were scattered opaque milary tubercles, some gritty in the centre. The kidneys showed several projecting nodules up to 4 mm. in diameter; some were soft and caseous in the centres, and extended as radial streaks; the right pelvis was filled with curdy caseo-pus. Lungs were crepitant and contained a moderate number of hard grey milary tubercles with caseous centres and a few larger grey nodules. Other organs and glands normal.
P. IV.	Original material.	10 mg.	21 days old, 11th generation.	183 days	463	1,750	1,220	September 20th, 1905.	Died 18 days.	Omentum slightly thickened and composed of pinkish-grey and caseated tissues. Peritoneum closely covered with minute greyish-white tubercles. The spleen was enlarged, and the malpighian bodies prominent, but there were no tubercles. The liver showed moderately numerous grey points, and the kidneys a few. The lungs were congested, and showed numerous minute grey tubercles about 5 mm. in diameter, only one caseous in the centre. Caseous foci and patches in the portal, coeliac, mesenteric and bronchial glands. A few tubercle bacilli were demonstrated in the spleen and liver.
P. IV.	Original material.	10 mg.	20 days old, 5th generation.	76 days	310	1,590	1,600	June 5th, 1905	Killed 87 days.	Caseo-purulent cyst in the subcutaneous tissue at the seat of inoculation. There were a few soft caseous nodules, one the size of a thrush's egg, in the omentum, and similar nodules in the small omentum, on the bladder and rectum, and in the lumbar regions. On the mesentery there were groups of confluent grey tubercles. On the surfaces of the liver and spleen there were a few tubercles, but the substance of both was normal. In the cortices of the kidneys there were scattered caseous tubercles. In the lungs there were discrete milary caseous tubercles coalescing to form patches on the surfaces of the caudal lobes and in the margins.

INTRAPERITONEAL INOCULATIONS OF RABBITS WITH CULTURES OF SLIGHTLY VIRULENT TUBERCLES OF PORCINE ORIGIN—*continued*.

Virus.	Source of Culture.	Dose.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
						Initial.	Final.			
P. XLI.	Original material.	1.0 mg.	21 days old, 8th generation.	175 days	1053	2,300	1,450	November 15th, 1906.	Died 23 days.	Slight tuberculosis of the omentum and peritoneum. A few grey foci in the lungs and kidneys in which no tubercle bacilli were demonstrated. A few opaque foci in the mediastinal glands. No tuberculosis elsewhere.
P. XLI.	Original material.	1.0 mg.	21 days old, 10th generation.	245 days	1213	1,300	1,060	January 24th, 1907.	Died 40 days.	Slight tuberculosis of omentum and peritoneum. On the surface of the lungs there were a few translucent tubercles with caseous centres. The cortices of the kidneys showed minute pits with one caseous streak in the medulla. Caseous tubercles in the mediastinal and portal glands. No tuberculosis elsewhere.
P. XLI.	Original material.	10 mg.	21 days old, 8th generation.	175 days	1054	2,550	2,570	November 15th, 1906.	Killed 99 days.	Omentum contained discrete grey nodules, with soft, caseous, slightly-gritty centres, and cysticerci filled with caseo-pus. There were similar scattered nodules on the peritoneum. The cortices of the kidneys showed a moderate number of grey nodules filled with caseo-pus, many extending as soft caseous streaks through the pyramids; the pelvis of one kidney was filled with caseo-pus. The lungs showed a few minute grey tubercles and one small caseous nodule. Soft caseous nodules in the sternal and mediastinal glands.
P. XLVI.	Original material.	1.0 mg.	21 days old, 7th generation.	136 days	1047	3,400	3,500	November 15th, 1906.	Killed 100 days.	In the omentum and on the peritoneum there were a few translucent tubercles with soft caseous centres. A grey miliary nodule was seen in the spleen. In the kidneys there were a few grey tubercles with caseous centres, and also two projecting nodules up to a small pea in size. The lungs contained scattered grey tubercles, and also three nodules up to 1 cm. in diameter, consisting of grey capsules filled with caseo-pus; the margins of the posterior lobes were replaced by grey tissue with caseous foci. No disease elsewhere.
P. XLVI.	Original material.	10 mg.	21 days old, 7th generation.	136 days	1048	2,900	2,650	November 15th, 1906.	Killed 100 days.	In the omentum and peritoneum there were moderately numerous flat grey nodules with caseous centres up to a hemp seed. Spleen and liver normal. The kidneys showed on the surface scattered translucent nodules up to 4 mm., which on section contained soft caseous substance; these extended as caseous streaks through the pyramids. Opaque gritty foci in a lumbar gland. Lungs collapsed normally and showed moderately numerous flat grey nodules with caseous foci on the surface and in the margins. Caseo-purulent nodule in a mediastinal gland.

P. IV.	Original material.	0.1 mg.	20 days old, 5th generation.	76 days	313	870	920	June 5th, 1905	Killed 88 days.	Caseo-purulent local lesion. In each lung there were about half-a-dozen caseous nodules with grey margins. No tuberculosis elsewhere.
P. IV.	Original material.	1.0 mg.	20 days old, 5th generation.	76 days	311	1,510	1,940	June 5th, 1905	Killed 88 days.	Caseo-purulent local lesion. Soft caseous nodules in the inguinal glands. In the lungs there were about three dozen irregular nodules up to 2.5 mm.; they were caseous in the centre, some being softened, and were situated mainly under the pleura. Other organs and glands normal.
P. IV.	Original material.	10 mg.	20 days old, 5th generation.	76 days	309	1,700	2,220	June 5th, 1905	Killed 88 days.	Caseo-purulent cyst in the subcutaneous tissue. In the lungs there were scattered nodules with little caseation varying in size from a millet seed up to 1 cm. in diameter. Other organs and lymphatic glands normal.
P. IV.	Original material.	10 mg.	21 days old, 11th generation.	183 days	464	1,270	1,410	September 20th, 1905.	Killed 90 days.	Small ulcer in the skin and a group of soft caseous nodules in the subcutaneous tissue. Caseo-purulent nodules in the nearest glands. The left kidney showed one yellow tubercle continued as a caseous streak through the pyramids. The lungs contained a few hard grey nodules with very little central caseation, varying up to a small pea in size. No tuberculosis elsewhere.
P. XLI.	Original material.	10 mg.	21 days old, 8th generation.	175 days	1055	1,500	2,200	November 15th, 1906.	Killed 99 days.	Caseo-purulent cyst at the seat of inoculation. On the surface of the lungs there were a few grey tubercles with minute caseous foci. No tuberculosis elsewhere.
P. XLI.	Original material.	50 mg.	21 days old, 8th generation.	175 days	1056	1,950	1,360	November 15th, 1906.	Died 45 days.	Large septic ulcer lined with caseous substance in the skin of back. Soft caseous nodules in axillary glands. A few translucent tubercles on the surface of the lungs. No tuberculosis elsewhere.
P. XLI.	Original material.	100 mg.	21 days old, 10th generation.	245 days	1214	1,270	920	January 24th, 1907.	Died 24 days.	At the seat of inoculation there was a caseo-purulent cyst. No tuberculosis elsewhere. Death due to a strangulated umbilical hernia.
P. XLI.	Lung of Pig 166.	10 mg.	20 days old, 7th generation.	136 days	1478	960	2,330	September 20th, 1907.	Killed 146 days.	Small ulcer in the skin of the back. Right scapular gland contained a few yellow gritty foci. No disease elsewhere.
P. XLI.	Lung of Pig 166.	50 mg.	20 days old, 7th generation.	136 days	1480	1,050	2,350	September 20th, 1907.	Killed 146 days.	In the subcutaneous tissue of the back there was a lobulated cystic tumour; it was filled with soft caseous substance which was discharging through a small ulcer in the skin. No disease elsewhere.
P. XLI.	Lung of Pig 202.	50 mg.	16 days old, 7th generation.	110 days	1701	1,280	1,620	March 12th, 1908.	Killed 174 days.	Cystic local tumour filled with caseo-pus. In the right kidney there was a caseating nodule the size of a hemp seed. On the dorsal surface of the posterior lobes of the lungs there were a few minute tubercles and one firm yellow marginal nodule. No disease elsewhere.
P. XLI.	Lung of Pig 202.	50 mg.	16 days old, 7th generation.	110 days	1702	1,260	2,100	March 12th, 1908.	Killed 174 days.	Caseo-purulent nodule in the subcutaneous tissues of the back. Axillary and scapular glands enlarged and filled with yellow caseo-pus. In each lung there was a soft caseous gritty miliary tubercle. No disease elsewhere.
P. XLI.	Lung of Pig 258.	38 mg.	21 days old, 2nd generation.	35 days	1864	750	1,790	July 28th, 1908.	Killed 100 days.	Caseo-purulent nodules in the subcutaneous tissue of the back. In the lungs, mainly in the caudal margins, there were a few minute translucent tubercles. No tuberculosis elsewhere.
P. XLVI.	Original material.	60 mg.	21 days old, 7th generation.	136 days	1050	2,000	2,150	November 15th, 1906.	Killed 100 days.	Large caseo-purulent cyst in the subcutaneous tissue. A minute grey tubercle in one lung. Other organs and glands were normal.

INOCULATIONS OF RABBITS WITH THE ORIGINAL MATERIAL OF THE PORCINE VIRUSES.

Virus.	Material Used.	Number of Rabbit.	Weight in Grammes.		Method of Inoculation.	Date of Inoculation.	Duration of Life.	Result.
			Initial.	Final.				
P. XV.	Submaxillary gland	381	860	1,020	Intraperitoneal	August 1st, 1905	Died 48 days	General tuberculosis.
P. XX.	Submaxillary gland	554	1,930	1,190	Intraperitoneal	December 1st, 1905	Died 67 days	General tuberculosis.
P. XXII.	Submaxillary gland	483	1,200	1,650	Intraperitoneal	September 29th, 1905	Killed 49 days	Slight tuberculosis.
P. XXIII.	Bronchial gland	484	1,150	800	Intraperitoneal	September 29th, 1905	Died 41 days	General tuberculosis.
P. XXIV.	Submaxillary gland	579	1,330	930	Intraperitoneal	December 8th, 1905	Died 16 days	Slight tuberculosis.
P. XXV.	Submaxillary gland	580	2,220	1,700	Intraperitoneal	December 8th, 1905	Killed 75 days	General tuberculosis.
P. XXVI.	Submaxillary gland	581	1,140	800	Intraperitoneal	December 8th, 1905	Died 18 days	General tuberculosis.
P. XXVIII.	Submaxillary gland	617	1,610	—	Intraperitoneal	December 21st, 1905	Killed 43 days	No tuberculosis.
		618	1,910	1,720	Intravenous		Killed 36 days	No tuberculosis.
P. XXIX.	Submaxillary gland	626	1,570	1,320	Intraperitoneal	December 21st, 1905	Died 30 days	General tuberculosis.
P. XXX.	Submaxillary gland	627	1,530	1,060	Intraperitoneal	December 21st, 1905	Died 60 days	General tuberculosis.
P. XXXI.	Submaxillary gland	628	1,570	1,240	Intraperitoneal	December 21st, 1905	Died 7 days	No tuberculosis.
P. XXXII.	Submaxillary gland	756	1,350	1,100	Subcutaneous	February 13th, 1906	Died 75 days	General tuberculosis.
		757	1,130	1,010	Intraperitoneal		Died 51 days	General tuberculosis.
P. XXXIII.	Submaxillary gland	769	1,170	760	Intraperitoneal	February 17th, 1906	Died 97 days	General tuberculosis.
		770	1,490	1,200	Subcutaneous		Died 108 days	General tuberculosis.
P. XXXIV.	Submaxillary gland	771	1,300	800	Intraperitoneal	February 17th, 1906	Died 119 days	General tuberculosis.
		772	1,360	880	Subcutaneous		Died 123 days	General tuberculosis.
P. XXXV.	Submaxillary gland	796	1,700	1,000	Intravenous	March 9th, 1906	Killed 56 days	No tuberculosis.
P. XXXVI.	Submaxillary gland	811	1,150	1,100	Subcutaneous	March 24th, 1906	Died 93 days	General tuberculosis.
P. XXXVII.	Submaxillary gland	812	1,100	870	Subcutaneous	March 24th, 1906	Died 93 days	General tuberculosis.
P. XLIII.	Submaxillary gland	904	1,820	1,850	Intravenous	June 12th, 1906	Killed 69 days	General tuberculosis.

P. XLV.	Submaxillary gland	943	1,400	—	Intraperitoneal	July 3rd, 1906	Died 10 days	Psoro-spermosis of liver.
P. XLVI.	Submaxillary gland	944	1,700	2,100	Intraperitoneal	July 3rd, 1906	Killed 44 days	No tuberculosis.
P. XLVII.	Submaxillary gland	945	1,750	1,850	Intraperitoneal	July 3rd, 1906	Killed 44 days	General tuberculosis.
P. XLVIII.	Submaxillary gland	946	1,800	2,200	Intraperitoneal	July 3rd, 1906	Killed 44 days	General tuberculosis.
P. LVI.	Lung II.	1315	1,500	1,360	Intraperitoneal	April 20th, 1907	Died 123 days	General tuberculosis.
	Mesenteric gland	1316	1,300	1,050	Subcutaneous		Died 3 days	Acute infection.
	Lung I.	1317	1,050	960	Subcutaneous		Died 125 days	General tuberculosis.
P. LVII.	Submaxillary gland	1336	1,050	870	Intraperitoneal	May 17th, 1907	Died 71 days	General tuberculosis.
	Bronchial gland	1337	980	770	Intraperitoneal		Died 5 days	Psorospermosis of liver. No tubercu- losis.
	Mesenteric gland	1338	1,140	1,310	Subcutaneous		Died 104 days	General tuberculosis.
		1339	1,050	1,200	Intraperitoneal		Killed 106 days	Chronic general tuberculosis.
P. LVIII.	Spleen	1346	1,550	2,050	Intraperitoneal	May 28th, 1907	Died 68 days	Early general tuberculosis.
	Liver	1347	1,110	820	Intraperitoneal		Died 9 days	No tuberculosis.
P. LIX.	Submaxillary gland	1363	1,650	1,370	Intraperitoneal	June 6th, 1907	Died 86 days	General tuberculosis.
	Synovial membrane	1364	1,050	1,620	Intraperitoneal		Died 98 days	General tuberculosis.
	Bronchial gland	1365	1,300	1,320	Intraperitoneal		Died 48 days	General tuberculosis.
P. LX.	Spleen	1366	1,550	1,800	Intraperitoneal	June 6th, 1907	Killed 85 days	Early general tuberculosis.
P. LXI.	Bronchial gland	1375	1,920	1,640	Intraperitoneal	June 29th, 1907	Died 96 days	General tuberculosis.
	Portal gland	1376	1,200	1,160	Intraperitoneal		Died 53 days	General tuberculosis.
P. LXII.	Spleen	1377	1,770	1,750	Intraperitoneal	June 29th, 1907	Died 92 days	General tuberculosis.
	Lung	1378	1,470	1,590	Intraperitoneal		Died 122 days	General tuberculosis.

INTRAPERITONEAL INOCULATIONS OF GUINEA-PIGS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.

DOSE IN EACH CASE : 1.0 milligramme.

Virus.	Source of Culture.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Guinea-pig.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
					Initial.	Final.			
P. XII.	Guinea-pig 1636	21 days old, 9th generation	298 days	2123	470	300	June 29th, 1906	Died 11 days	General tuberculosis.
P. XXXVI.	Original material	21 days old, 10th generation	245 days	2225	450	280	Nov. 23rd, 1906	Died 12 days	General tuberculosis.
P. XXXVII.	Original material	21 days old, 10th generation	245 days	2229	400	270	Nov. 23rd, 1906	Died 10 days	General tuberculosis.
P. XXXVIII.	Original material	21 days old, 8th generation	193 days	2233	540	420	Nov. 24th, 1906	Died 13 days	General tuberculosis.
P. XXXIX.	Original material	21 days old, 6th generation	196 days	2237	300	300	Nov. 27th, 1906	Died 15 days	General tuberculosis.
P. XL.	Original material	21 days old, 8th generation	196 days	2241	350	280	Nov. 27th, 1906	Died 16 days	General tuberculosis.
P. XLII.	Original material	21 days old, 8th generation	177 days	2208	520	350	Nov. 17th, 1906	Died 11 days	General tuberculosis.
P. XLIII.	Original material	21 days old, 6th generation	169 days	2247	370	240	Nov. 28th, 1906	Died 13 days	General tuberculosis.
P. XLVII.	Original material	21 days old, 8th generation	183 days	2255	450	400	Dec. 4th, 1906	Died 11 days	General tuberculosis.
P. XLIX.	Original material	21 days old, 6th generation	157 days	2332	300	220	Jan. 19th, 1906	Died 10 days	General tuberculosis.
P. L.	Original material	25 days old, 7th generation	141 days	2280	350	300	Jan. 3rd, 1906	Died 47 days	General tuberculosis. Inoculation partly subcutaneous.
P. LI.	Original material	16 days old, 5th generation	95 days	2324	370	350	Jan. 18th, 1906	Died 9 days	General tuberculosis.
P. LII.	Original material	20 days old, 5th generation	95 days	2328	570	420	Jan. 18th, 1906	Died 9 days	General tuberculosis.

DOSE IN EACH CASE : 0.1 milligramme.

P. I.	Original material	21 days old, 8th generation	138 days	1630	300	190	July 19th, 1905	Died 16 days	General tuberculosis.
P. V.	Original material	20 days old, 7th generation	134 days	1655	320	210	Aug. 30th, 1905	Died 14 days	General tuberculosis.
P. VI.	Guinea-pig 1515	20 days old, 6th generation	126 days	1657	560	380	Sept. 1st, 1905	Died 13 days	General tuberculosis.
P. VII.	Original material	20 days old, 8th generation	144 days	1702	560	370	Sept. 18th, 1905	Died 16 days	General tuberculosis.
P. VIII.	Original material	20 days old, 5th generation	117 days	1673	590	390	Sept. 5th, 1905	Died 12 days	General tuberculosis.

P. IX.	Original material	20 days old, 7th generation	1706	510	490	Sept. 20th, 1905	Died 14 days	General tuberculosis.
P. X.	Original material	21 days old, 5th generation	1690	580	420	Sept. 11th, 1905	Died 15 days	General tuberculosis.
P. XI.	Original material	20·5 days old, 4th generation	1678	620	420	Sept. 6th, 1905	Died 15 days	General tuberculosis.
P. XII.	Guinea-pig 1636	20 days old, 5th generation	1802	350	260	Dec. 14th, 1905	Died 18 days	General tuberculosis.
P. XIII.	Guinea-pig 1636	21 days old, 9th generation	2121	350	200	June 29th, 1906	Died 19 days	General tuberculosis.
P. XIV.	Original material	21 days old, 6th generation	1763	410	260	Oct. 30th, 1905	Died 14 days	General tuberculosis.
P. XV.	Guinea-pig 1623	21 days old, 6th generation	1808	430	260	Jan. 29th, 1906	Died 17 days	General tuberculosis.
P. XVI.	Original material	20 days old, 8th generation	1784	310	200	Nov. 23rd, 1905	Died 10 days	General tuberculosis.
P. XVII.	Original material	20 days old, 5th generation	1782	260	200	Nov. 22nd, 1905	Died 11 days	General tuberculosis.
P. XVIII.	Original material	20 days old, 6th generation	1807	240	210	Dec. 15th, 1905	Died 19 days	General tuberculosis.
P. XIX.	Original material	20 days old, 6th generation	1794	360	270	Dec. 11th, 1905	Died 18 days	General tuberculosis.
P. XX.	Original material	20 days old, 6th generation	1814	340	250	Dec. 20th, 1905	Died 14 days	General tuberculosis.
P. XX.	Original material	21 days old, 5th generation	1918	660	390	Feb. 23rd, 1906	Died 13 days	General tuberculosis.
P. XXII.	Original material	21 days old, 4th generation	1804	290	170	Dec. 14th, 1905	Died 21 days	General tuberculosis.
P. XXIII.	Original material	21 days old, 6th generation	1862	340	280	Jan. 22nd, 1906	Died 59 days	General tuberculosis.
P. XXIV.	Guinea-pig 1790	20 days old, 3rd generation	1943	510	280	March 20th, 1906	Died 14 days	General tuberculosis.
P. XXV.	Original material	6 days old, 6th generation	1916	650	420	Feb. 22nd, 1906	Died 13 days	General tuberculosis.
P. XXVI.	Original material	22 days old, 6th generation	1967	540	390	April 13th, 1906	Died 15 days	General tuberculosis.
P. XXIX.	Original material	21 days old, 5th generation	1965	620	390	April 13th, 1906	Died 14 days	General tuberculosis.
P. XXX.	Original material	19 days old, 6th generation	1982	520	300	May 1st, 1906	Died 16 days	General tuberculosis.
P. XXXI.	Original material	20 days old, 6th generation	2026	570	370	May 9th, 1906	Died 13 days	General tuberculosis.
P. XXXII.	Original material	21 days old, 7th generation	2134	610	400	July 5th, 1906	Died 17 days	General tuberculosis.
P. XXXIII.	Original material	22 days old, 7th generation	2136	480	310	July 5th, 1906	Killed when dying, 20 days	General tuberculosis.
P. XXXIV.	Original material	22 days old, 7th generation	2141	430	480	July 6th, 1906	Died 50 days	General tuberculosis. Inoculation partly subcutaneous.
P. XXXVI.	Original material	21 days old, 10th generation	2223	420	320	Nov. 23rd, 1906	Died 17 days	General tuberculosis.
P. XXXVII.	Original material	21 days old, 10th generation	2227	370	230	Nov. 23rd, 1906	Died 18 days	General tuberculosis.

INTRAPERITONEAL INOCULATIONS OF GUINEA-PIGS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN—*continued*.

DOSE IN EACH CASE: 0.1 milligramme—*continued*.

Virus.	Source of Culture.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Guinea-pig.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
					Initial.	Final.			
P. XXXVIII.	Original material	21 days old, 8th generation	193 days	2231	380	340	Nov. 24th, 1906	Died 15 days	General tuberculosis.
P. XXXIX.	Original material	21 days old, 6th generation	196 days	2235	450	450	Nov. 27th, 1906	Died 11 days	General tuberculosis.
P. XL.	Original material	21 days old, 8th generation	196 days	2239	400	350	Nov. 27th, 1906	Died 21 days	General tuberculosis.
P. XLII.	Original material	21 days old, 8th generation	177 days	2206	400	350	Nov. 17th, 1906	Died 26 days	General tuberculosis.
P. XLIII.	Original material	21 days old, 6th generation	169 days	2245	300	300	Nov. 28th, 1906	Died 27 days	General tuberculosis.
P. XLVII.	Original material	21 days old, 8th generation	183 days	2253	470	450	Dec. 4th, 1906	Died 13 days	General tuberculosis.
P. XLIX.	Original material	21 days old, 6th generation	157 days	2330	320	240	Jan. 19th, 1907	Died 10 days	General tuberculosis.
P. L.	Original material	25 days old, 7th generation	141 days	2278	550	400	Jan. 3rd, 1907	Died 61 days	General tuberculosis. Inoculation partly subcutaneous.
P. LI.	Original material	16 days old, 5th generation	95 days	2322	400	270	Jan. 18th, 1907	Died 13 days	General tuberculosis.
P. LII.	Original material	20 days old, 5th generation	95 days	2326	470	370	Jan. 18th, 1907	Died 13 days	General tuberculosis.
P. LIII.	Original material	21 days old, 8th generation	185 days	2570	780	500	July 15th, 1907	Died 17 days	General tuberculosis.
P. LIV.	Original material	21 days old, 7th generation	185 days	2572	920	600	July 15th, 1907	Died 21 days	General tuberculosis.
P. LV.	Original material	22 days old, 7th generation	186 days	2574	650	400	July 16th, 1907	Died 19 days	General tuberculosis.
P. LVI.	Original material	21 days old, 5th generation	143 days	2608	370	270	Sept. 9th, 1907	Died 20 days	General tuberculosis.
P. LVII.	Original material	21 days old, 5th generation	117 days	2612	370	200	Sept. 10th, 1907	Died 16 days	General tuberculosis.
P. LVIII.	Original material	21 days old, 6th generation	129 days	2678	450	240	Oct. 3rd, 1907	Died 13 days	General tuberculosis.
P. LIX.	Original material	21 days old, 6th generation	119 days	2668	540	300	Oct. 2nd, 1907	Died 20 days	General tuberculosis.
P. LX.	Original material	14 days old, 6th generation	118 days	2658	480	280	Oct. 1st, 1907	Died 17 days	General tuberculosis.
P. LXI.	Original material	21 days old, 5th generation	101 days	2715	600	400	Oct. 8th, 1907	Died 19 days	General tuberculosis.
P. LXII.	Original material	21 days old, 5th generation	107 days	2751	250	190	Oct. 14th, 1907	Died 16 days	General tuberculosis. Inoculation wholly subcutaneous.
P. LXIII.	Original material	24 days old, 4th generation	94 days	2795	550	350	Oct. 22nd, 1907	Died 50 days	General tuberculosis.

DOSE IN EACH CASE 1.0 milligramme.

P. XII.	Guinea-pig 1636	21 days old, 9th generation	298 days	2122	440	220	June 29th, 1906	Died 52 days	General tuberculosis.
P. XXXVI.	Original material	21 days old, 10th generation	245 days	2224	450	320	Nov. 23rd, 1906	Died 44 days	General tuberculosis.
P. XXXVII.	Original material	21 days old, 10th generation	245 days	2228	400	280	Nov. 23rd, 1906	Died 46 days	General tuberculosis.
P. XXXVIII.	Original material	21 days old, 8th generation	193 days	2232	360	350	Nov. 24th, 1906	Died 38 days	General tuberculosis.
P. XXXIX.	Original material	21 days old, 6th generation	196 days	2236	320	350	Nov. 27th, 1906	Died 61 days	General tuberculosis.
P. XL.	Original material	21 days old, 8th generation	196 days	2240	500	400	Nov. 27th, 1906	Died 16 days	General tuberculosis. Inoculation intraperitoneal.
P. XLII.	Original material	21 days old, 8th generation	177 days	2207	500	300	Nov. 17th, 1906	Died 54 days	General tuberculosis.
P. XLIII.	Original material	21 days old, 6th generation	169 days	2246	370	340	Nov. 28th, 1906	Died 52 days	General tuberculosis.
P. XLVII.	Original material	21 days old, 8th generation	183 days	2254	500	350	Dec. 4th, 1906	Died 76 days	General tuberculosis.
P. XLIX.	Original material	21 days old, 6th generation	157 days	2331	240	200	Jan. 19th, 1907	Died 36 days	General tuberculosis.
P. L.	Original material	25 days old, 7th generation	141 days	2279	350	270	Jan. 3rd, 1907	Died 29 days	General tuberculosis.
P. LI.	Original material	16 days old, 5th generation	95 days	2323	470	400	Jan. 18th, 1907	Died 39 days	General tuberculosis.
P. LII.	Original material	20 days old, 5th generation	95 days	2327	550	380	Jan. 18th, 1907	Died 45 days	General tuberculosis.

DOSE IN EACH CASE: 0.1 milligramme.

P. I.	Original material	21 days old, 8th generation	138 days	1629	260	230	July 19th, 1905	Died 37 days	General tuberculosis.
P. V.	Original material	20 days old, 7th generation	134 days	1654	320	260	Aug. 30th, 1905	Died 49 days	General tuberculosis.
P. VI.	Guinea-pig 1515	20 days old, 6th generation	126 days	1656	370	250	Sept. 1st, 1905	Died 36 days	General tuberculosis.
P. VII.	Original material	20 days old, 8th generation	144 days	1701	620	500	Sept. 18th, 1905	Died 33 days	General tuberculosis.
P. VIII.	Original material	20 days old, 5th generation	117 days	1672	460	—	Sept. 5th, 1905	Died 5 days	Death from colitis.
P. IX.	Original material	20 days old, 7th generation	125 days	1705	610	430	Sept. 20th, 1905	Died 42 days	General tuberculosis.
P. X.	Original material	21 days old, 5th generation	116 days	1689	670	380	Sept. 11th, 1905	Died 43 days	General tuberculosis.

SUBCUTANEOUS INOCULATIONS OF GUINEA-PIGS WITH CULTURES OF VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN—*continued*.
DOSE IN EACH CASE: 0.1 milligramme—*continued*.

Virus.	Source of Culture.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Guinea-pig.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
					Initial.	Final.			
P. XI.	Original material	20.5 days old, 4th generation	97 days	1677	630	460	Sept. 6th, 1905	Died 34 days	General tuberculosis.
P. XII.	Guinea-pig 1636	20 days old, 5th generation	101 days	1801	320	400	Dec. 14th, 1905	Died 83 days	General tuberculosis.
	Guinea-pig 1636	21 days old, 9th generation	298 days	2120	400	230	June 29th, 1906	Died 53 days	General tuberculosis.
P. XIII.	Original material	21 days old, 6th generation	116 days	1762	460	300	Oct. 30th, 1905	Died 37 days	General tuberculosis.
P. XIV.	Guinea-pig 1623	21 days old, 6th generation	139 days	1867	380	250	Jan. 29th, 1906	Died 41 days	General tuberculosis.
P. XV.	Original material	20 days old, 8th generation	114 days	1783	320	250	Nov. 23rd, 1905	Died 48 days	General tuberculosis.
P. XVI.	Original material	20 days old, 5th generation	100 days	1781	380	280	Nov. 22nd, 1905	Died 49 days	General tuberculosis.
P. XVII.	Original material	20 days old, 6th generation	123 days	1806	340	230	Dec. 15th, 1905	Died 53 days	General tuberculosis.
P. XVIII.	Original material	20 days old, 6th generation	119 days	1793	390	250	Dec. 11th, 1905	Died 56 days	General tuberculosis.
P. XIX.	Original material	20 days old, 6th generation	128 days	1813	250	200	Dec. 20th, 1905	Died 41 days	General tuberculosis.
P. XX.	Original material	21 days old, 5th generation	85 days	1917	590	330	Feb. 23rd, 1906	Died 40 days	General tuberculosis.
P. XXII.	Original material	21 days old, 4th generation	77 days	1803	400	380	Dec. 14th, 1905	Died 57 days	General tuberculosis.
P. XXIII.	Original material	21 days old, 6th generation	116 days	1861	320	300	Jan. 22nd, 1906	Died 59 days	General tuberculosis.
P. XXIV.	Guinea-pig 1790	20 days old, 3rd generation	102 days	1942	370	200	March 28th, 1906	Died 26 days	General tuberculosis.
P. XXV.	Original material	6 days old, 6th generation	76 days	1915	800	420	Feb. 22nd, 1906	Died 34 days	General tuberculosis.
P. XXVI.	Original material	22 days old, 6th generation	126 days	1966	670	470	April 13th, 1906	Died 37 days	General tuberculosis.
P. XXIX.	Original material	21 days old, 5th generation	114 days	1964	600	400	April 13th, 1906	Died 45 days	General tuberculosis.
P. XXX.	Original material	19 days old, 6th generation	132 days	1981	400	210	May 1st, 1906	Died 36 days	General tuberculosis.
P. XXXI.	Original material	20 days old, 6th generation	140 days	2025	520	270	May 9th, 1906	Died 35 days	General tuberculosis.
P. XXXII.	Original material	21 days old, 7th generation	143 days	2133	690	400	July 5th, 1906	Died 51 days	General tuberculosis.
P. XXXIII.	Original material	22 days old, 7th generation	140 days	2135	670	270	July 5th, 1906	Died 35 days	General tuberculosis.

P. XXXIV.

P. XXXVI.

P. XXXVII.

P. XXXVIII.

P. XXXIX.

P. XL.

P. XLII.

P. XLIII.

P. XLVII.

P. XLIX.

P. L.

P. LI.

P. LII.

P. LIII.

P. LIV.

P. LV.

P. LVI.

P. LVII.

P. LVIII.

P. LIX.

P. LX.

P. LXI.

P. LXII.

P. LXIII.

Original material

Original material

Original material

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Original material

22 days old, 7th generation

21 days old, 10th generation

21 days old, 10th generation

21 days old, 8th generation

21 days old, 6th generation

21 days old, 8th generation
20 days old, 10th generation

21 days old, 8th generation

21 days old, 6th generation

21 days old, 8th generation

21 days old, 6th generation

25 days old, 7th generation

16 days old, 5th generation

20 days old, 5th generation

21 days old, 8th generation

21 days old, 7th generation

22 days old, 7th generation

21 days old, 5th generation

21 days old, 5th generation

21 days old, 5th generation

21 days old, 6th generation

14 days old, 6th generation

21 days old, 5th generation

21 days old, 5th generation

24 days old, 4th generation

140 days

245 days

245 days

193 days

196 days

196 days
328 days

177 days

169 days

183 days

157 days

141 days

95 days

95 days

185 days

185 days

186 days

143 days

117 days

129 days

119 days

118 days

101 days

107 days

94 days

2140

2222

2226

2230

2234

2238
2417

2205

2244

2252

2329

2277

2321

2325

2569

2571

2573

2607

2611

2677

2667

2657

2714

2750

2796

470

470

420

450

350

400
530

320

300

520

300

430

520

320

950

750

850

370

330

350

470

470

350

230

650

350

400

280

300

330

320
400

300

370

550

230

270

330

270

520

700

460

250

240

270

330

290

240

200

390

July 6th, 1906

Nov. 23rd, 1906

Nov. 23rd, 1906

Nov. 24th, 1906

Nov. 27th, 1906

Nov. 27th, 1906
April 8th, 1907

Nov. 17th, 1906

Nov. 28th, 1906

Dec. 4th, 1906

Jan. 19th, 1907

Jan. 3rd, 1907

Jan. 18th, 1907

Jan. 18th, 1907

July 15th, 1907

July 15th, 1907

July 16th, 1907

Sept. 9th, 1907

Sept. 10th, 1907

Oct. 3rd, 1907

Oct. 2nd, 1907

Oct. 1st, 1907

Oct. 10th, 1907

Oct. 14th, 1907

Oct. 22nd, 1907

Died 60 days

Died 57 days

Died 42 days

Died 14 days

Died 42 days

Died 15 days
Died 31 days

Died 62 days

Died 55 days

Died 75 days

Died 29 days

Died 47 days

Died 46 days

Died 39 days

Died 47 days

Died 54 days

Died 36 days

Died 44 days

Died 52 days

Died 41 days

Died 44 days

Died 38 days

Died 36 days

Died 39 days

Died 42 days

General tuberculosis.

General tuberculosis.

General tuberculosis.

Early general tuberculosis.
oculation intraperitoneal.
General tuberculosis.

Early general tuberculosis.
oculation intraperitoneal.
General tuberculosis.

General tuberculosis.

General tuberculosis.

General tuberculosis.

General tuberculosis.

General tuberculosis.

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General tuberculosis.

General tuberculosis.

General tuberculosis.

INTRAPERITONEAL INOCULATIONS OF GUINEA-PIGS WITH CULTURES OF SLIGHTLY VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.

Virus.	Source of Culture.	Dose.	Age and Generation of Subculture Inoculated.	Total Duration of Cultivation.	Number of Guinea-pig.	Weight in Grammes.		Date of Inoculation.	Duration of Life.	Result.
						Initial.	Final.			
P. IV.	Original material	0.1 mg.	20 days old, 5th generation	76 days	1569	410	280	June 5th, 1905	Died 21 days	General tuberculosis.
P. IV.	Original material	0.1 mg.	21 days old, 11th generation	183 days	1704	370	280	Sept. 20th, 1905	Died 18 days	General tuberculosis.
P. XLI.	Original material	0.1 mg.	21 days old, 8th generation	175 days	2194	450	380	Nov. 15th, 1906	Died 117 days	Chronic tuberculosis.—A very small amount of the dose had been inoculated into the peritoneal cavity, the needle having probably perforated the intestine. General tuberculosis.
P. XLI.	Original material	1.0 mg.	21 days old, 8th generation	175 days	2196	450	300	Nov. 15th, 1906	Died 18 days	General tuberculosis.
P. XLI.	Original material	1.0 mg.	21 days old, 10th generation	245 days	2341	270	200	Jan. 24th, 1907	Died 23 days	General tuberculosis.
P. XLI.	Original material	1.0 mg.	21 days old, 10th generation	245 days	2343	270	250	Jan. 24th, 1907	Died 17 days	General tuberculosis.
P. XLI.	Original material	1.0 mg.	21 days old, 10th generation	245 days	2344	300	240	Jan. 24th, 1907	Died 12 days	General tuberculosis.
P. XLVI.	Original material	0.1 mg.	21 days old, 7th generation	136 days	2190	600	400	Nov. 15th, 1906	Died 16 days	General tuberculosis.—The duration of life was shortened owing to strangulation of the intestine by a contracted omentum., General tuberculosis.
P. XLVI.	Original material	1.0 mg.	21 days old, 7th generation	136 days	2192	680	420	Nov. 15th, 1906	Died 19 days	General tuberculosis.

SUBCUTANEOUS INOCULATIONS OF GUINEA-PIGS WITH CULTURES OF SLIGHTLY VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.

P. IV.	Original material	0.1 mg.	20 days old, 5th generation	76 days	1568	480	270	June 5th, 1905	Died 36 days	General tuberculosis.
P. IV.	Original material	0.1 mg.	21 days old, 11th generation	183 days	1703	740	450	Sept. 20th, 1905	Died 41 days	General tuberculosis.
P. XLI.	Original material	0.1 mg.	21 days old, 8th generation	175 days	2193	400	270	Nov. 15th, 1906	Died 45 days	General tuberculosis.
P. XLI.	Original material	1.0 mg.	21 days old, 8th generation	175 days	2195	400	310	Nov. 15th, 1906	Died 58 days	General tuberculosis.
P. XLVI.	Original material	0.1 mg.	21 days old, 7th generation	136 days	2189	620	460	Nov. 15th, 1906	Died 47 days	General tuberculosis.
P. XLVI.	Original material	1.0 mg.	21 days old, 7th generation	136 days	2191	620	430	Nov. 15th, 1906	Died 81 days	General tuberculosis.

INOCULATIONS OF GUINEA-PIGS WITH ORIGINAL MATERIAL OF THE PORCINE VIRUSES.

Virus.	Material used.	Number of Guinea-pig.	Weight in Grammes.		Method of Inoculation.	Date of Inoculation.	Duration of Life.	Result.
			Initial.	Final.				
P. I.	Submaxillary gland	1455	450	630	Intraperitoneal	March 4th, 1905	Killed 37 days	General tuberculosis.
P. II.	Submaxillary gland	1461	280	350	Intraperitoneal	March 10th, 1905	Killed 31 days	Caseo-purulent nodules in the omentum. Purulent foci in pyloric, lumbar, and sternal glands.
P. III.	Submaxillary gland	1462	290	440	Intraperitoneal	March 10th, 1905	Killed 33 days	A few opaque foci in the omental.
P. IV.	Submaxillary gland	1468	400	300	Intraperitoneal	March 22nd, 1905	Died 72 days	Pyloric, and coeliac glands. General tuberculosis.
P. V.	Submaxillary gland	1510	200	270	Intraperitoneal	{ April 18th, 1905	Killed 37 days	General tuberculosis.
	Bronchial gland	1511	320	200	Intraperitoneal		Died 31 days	General tuberculosis.
P. VI.	Udder	1515	530	430	Intraperitoneal	April 28th, 1905	Died 24 days	General tuberculosis.
P. VII.	Submaxillary gland	1514	540	460	Intraperitoneal	April 28th, 1905	Died 46 days	General tuberculosis.
P. VIII.	Submaxillary gland	1535	490	430	Intraperitoneal	May 12th, 1905	Died 10 days	Sub-acute infection.
P. IX.	Submaxillary gland	1549	340	190	Intraperitoneal	May 19th, 1905	Died 30 days	General tuberculosis.
P. X.	Mesenteric gland	1550	570	370	Intraperitoneal	May 19th, 1905	Died 35 days	General tuberculosis.
P. XI.	Submaxillary gland	1559	520	440	Intraperitoneal	June 2nd, 1905	Died 16 days	General tuberculosis.
P. XII.	Submaxillary gland	1608	340	—	Intraperitoneal	June 27th, 1905	Died 1 day	Acute infection.
P. XIII.	Bronchial gland	1618	—	—	Intraperitoneal	July 7th, 1905	Died 34 days	General tuberculosis.
P. XIV.	Submaxillary gland	{ 1623	310	230	Subcutaneous	{ July 14th, 1905	Died 60 days	General tuberculosis.
			270	350	Intraperitoneal		Killed 52 days	General tuberculosis.
P. XV.	Submaxillary gland	1639	330	290	Subcutaneous	August 1st, 1905	Died 59 days	General tuberculosis.
P. XVI.	Bronchial gland	1640	320	300	Intraperitoneal	August 15th, 1905	Died 39 days	General tuberculosis.
P. XVII.	Mesenteric gland	1641	500	350	Intraperitoneal	August 15th, 1905	Died 39 days	General tuberculosis.
P. XVIII.	Lung	1642	340	230	Intraperitoneal	August 15th, 1905	Died 36 days	General tuberculosis.

INOCULATIONS OF GUINEA-PIGS WITH ORIGINAL MATERIAL OF THE PORCINE VIRUSES—*continued*.

Virus.	Material used.	Number of Guinea-pig.	Weight in Grammes.		Method of Inoculation.	Date of Inoculation.	Duration of Life.	Result.
			Initial.	Final.				
P. XIX.	Submaxillary gland	1643	340	300	Intraperitoneal	August 15th, 1905	Died 42 days	General tuberculosis.
P. XXI.	Submaxillary gland	1789	310	190	Intraperitoneal	December 5th, 1905	Killed 41 days	A single tubercle in the omentum.
P. XXIV.	Submaxillary gland	1790	390	360	Intraperitoneal	December 8th, 1905	Killed 32 days	Early general tuberculosis.
P. XXV.	Submaxillary gland	1791	370	290	Intraperitoneal	December 8th, 1905	Died 26 days	General tuberculosis.
P. XXVI.	Submaxillary gland	1792	400	360	Intraperitoneal	December 8th, 1905	Died 41 days	General tuberculosis.
P. XXVII.	Submaxillary gland	1799	260	210	Subcutaneous	December 12th, 1907	Killed 30 days	Purulent local lesion and foci in the inguinal glands.
P. XXVIII.	Submaxillary gland	1815	450	—	Subcutaneous	December 21st, 1905	Killed 36 days	No tuberculosis.
P. XXIX.	Submaxillary gland	1816	330	300	Subcutaneous	December 21st, 1905	Died 89 days	General tuberculosis.
P. XXX.	Submaxillary gland	1817	300	210	Subcutaneous	December 21st, 1905	Died 35 days	General tuberculosis.
P. XXXI.	Submaxillary gland	1818	390	260	Subcutaneous	December 21st, 1905	Died 35 days	General tuberculosis.
P. XXXIII.	Submaxillary gland	1909	350	290	Subcutaneous	February 16th, 1906	Died 94 days	General tuberculosis.
P. XXXIV.	Submaxillary gland	1910	320	210	Subcutaneous	February 16th, 1906	Died 53 days	General tuberculosis.
P. XXXV.	Submaxillary gland	1931	750	—	Subcutaneous	March 9th, 1906	Died 16 days	No tuberculosis.
P. XXXVIII.	Submaxillary gland	2030	260	180	Intraperitoneal	May 16th, 1906	Died 37 days	General tuberculosis.
P. XXXIX.	Submaxillary gland	2031	290	—	Intraperitoneal	May 16th, 1906	Died 7 days	Subacute infection.
P. XL.	Submaxillary gland	2032	290	230	Intraperitoneal	May 16th, 1906	Died 27 days	General tuberculosis.
P. XLI.	Submaxillary gland	2047	470	320	Intraperitoneal	May 25th, 1906	Killed 31 days	General tuberculosis.
P. XLIII.	Submaxillary gland	2076	620	520	Intraperitoneal	June 12th, 1906	Killed 57 days	General tuberculosis.
P. XLIV.	Submaxillary gland	2119	520	560	Intraperitoneal	June 29th, 1906	Killed 40 days	Animal healthy.
P. XLVIII.	Submaxillary gland	2124	540	—	Intraperitoneal	July 2nd, 1906	Died 8 days	Subacute infection.
P. LII.	Submaxillary gland	2166	500	450	Intraperitoneal	October 16th, 1906	Died 75 days	General tuberculosis.

TABULAR SUMMARY OF INOCULATION EXPERIMENTS ON RATS WITH VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN.

Virus.	Source of Culture.	No. of Rat.	Age and Generation of Culture.	Dose.	Date of Inoculation.	Duration of Life.		Result.
						Intrap.	Subcut.	
P. LVI.	Lung II. Mesenteric gland	2432	250	200	Intraperitoneal	April 20th, 1907	Died 47 days	General tuberculosis.
		2433	370	480	Intraperitoneal			No tuberculosis.
	Lung I.	2434	500	480	Intraperitoneal			Acute infection.
P. LVII.	Lung	2491	600	730	Intraperitoneal	May 17th, 1907	Died 75 days	General tuberculosis.
	Submaxillary gland	2492	560	490	Intraperitoneal			General tuberculosis.
	Bronchial gland	2493	880	550	Intraperitoneal			General tuberculosis.
	Spleen	2501	300	370	Intraperitoneal			General tuberculosis.
P. LVIII.	Liver	2502	400	700	Intraperitoneal	May 28th, 1907	Killed 91 days	General tuberculosis.
								Early general tuberculosis

At the seat of inoculation about the middle of the thigh there was a soft caseous mass about $\frac{1}{2}$ in. in diameter. The anterior lobes of the lungs were solid, and filled with yellowish pulaceous material; there were similar nodules in the posterior lobes (not tuberculous). Other organs and all glands appeared normal.

Microscopical.—Local lesion, swarms of T.B.; inguinal and iliac gland, very numerous T.B.; spleen, T.B. scanty; liver and lung, no T.B.

The omentum contained one small irregular greyish-white mass and two small groups of greyish-white tubercles; the former was adherent to the floor of the abdomen. The parietal peritoneum, serous surfaces of intestines, and mesentery were congested, but no tubercles were seen. The spleen was very large, and extended into the pelvis; it was dark red in colour, and showed a small yellow necrotic patch. The liver was pale. The kidneys were normal. Lungs: The left lung, with the exception of the posterior margin of the caudal lobe, and the right cephalic lobe were red and quite solid; the right middle and caudal lobes were crepitant, and congested in patches; no tubercles were seen; the bronchi contained thick yellow pus. The mediastinal glands were slightly enlarged and congested.

Microscopical examination (smears).—T.B. numerous in the omentum, liver, spleen, a mediastinal gland, and the right caudal lobe of lung; one T.B. found in a smear from a kidney; no T.B. in the blood or in the pus from a bronchus. The bacilli in the smears were often arranged in large clumps, and in the lung and mediastinal gland many were found inside cells.

TABULAR SUMMARY OF INOCULATION EXPERIMENTS ON RATS WITH VIRULENT TUBERCLE BACILLI OF PORCINE ORIGIN—continued.

Virus.	Source of Culture.	No. of Rat.	Age and Generation of Culture.	Dose.	Date of Inoculation.	Duration of Life.		RESULT.
						Intrap.	Subut.	
P. XIV.	Original material, through G.P. 1623.	95	6th generation, 21 days old.	10.0 mg.	Jan. 29, 1906.	—	211 days (killed).	In the adductor muscles of the left thigh at the seat of inoculation were two nodules containing whitish soft caseous substance, one the size of a millet seed, the other of a wheat grain. All organs and glands appeared normal. Microscopical.—Very numerous T.B. were seen in a smear from the local lesion, and a moderate number in a smear from the lung; no T.B. were seen in liver, kidney, or spleen. The omentum and peritoneum appeared normal. The spleen was a little enlarged and firm. The lungs contained two or three patches of congestion in which numerous T.B. were found. The sternal glands were a little enlarged and firm. Other organs and glands appeared normal. Microscopical.—Kidney, liver, sternal and lumbar glands showed numerous T.B.; spleen and lungs, more numerous T.B.
"	"	96	"	10.0 mg.	"	26 days (died).	—	
P. XV.	Original material.	88	8th generation, 20 days old.	40.0 mg.	Nov. 23, 1905.	2 days (died).	—	
"	Blood of Rat 88.	94	2nd generation, 19 days old.	5.0 mg.	Jan. 3, 1906.	62 days (died).	—	
"	Blood of Rat 94.	97	2nd generation, 18 days old.	The growth from one serum tube.	April 9, 1906.	44 days (killed).	—	On the ligament of the liver was a small nodule containing soft pus. The omentum was not affected. The spleen was considerably enlarged. Microscopical.—Peritoneal nodule, swarming with T.B.; liver, T.B. in clumps; kidney, T.B. fairly numerous; lung and spleen, T.B. very numerous. No omental or peritoneal disease; spleen, dark red, firm, and a little enlarged; lungs, expanded, mottled with congestion—no tubercles; liver and kidneys, normal. Microscopical.—T.B. very numerous in spleen; numerous in lungs; none found in liver and kidneys.
"	Rat 97.	93	2nd generation, 9 days old.	The growth from one serum tube.	June 22, 1906.	57 days (died).	—	
P. XIX.	Original material (submaxillary gland).	91	6th generation, 20 days old.	25.0 mg.	Dec. 20, 1905.	—	253 days (killed).	

At the seat of inoculation, in the left thigh, beneath the skin, was a caseous nodule the size of a wheat grain. All organs and glands appeared normal.
Microscopical.—Local lesion, T.B. very numerous; lung and spleen, T.B. fairly numerous; liver, no T.B. seen.

P. IV.	Original material.	74	5th generation, 20 days old.	20.0 mg.	June 5, 1905	5 days (died).	—	<p>In the subcutaneous tissues of the abdominal wall there was a focus of yellowish white pus. The omentum was drawn up, thickened, yellowish and nodular on the surface; on section it was composed of translucent grey tissue surrounding large foci of softening. There were two or three caseous tubercles in the small omentum. Parietal peritoneum normal. Intestines deeply congested. Mesenteric glands perhaps slightly enlarged. Other organs and glands normal.</p> <p>Microscopical Examination.—Very numerous T.B. in omentum; numerous T.B. in liver, spleen, lung, and a ventral mediastinal gland.</p>
"	"	82	11th generation, 21 days old.	20.0 mg.	Sept. 20, 1905	—	204 days (killed).	<p>The skin of the abdomen showed a small ridge at the base of one side, of which there was a little dried secretion (site of old ulcer). All the lymphatic glands and organs appeared normal.</p> <p>Microscopical Examination.—Few T.B. in smears from inguinal gland and lung; one seen in spleen smear.</p>
"	"	83	"	20.0 mg.	"	18 days (died).	—	<p>In the subcutaneous tissues near the left groin there was a nodule the size of a wheat grain filled with yellow pus. The omentum was adherent to a coil of the small intestine by a fibrous adhesion containing yellow purulent foci; in the gastro-splenic omentum there was a nodule the size of a small bean with fibrous walls and yellow purulent contents. On the mesentery were two millet seed sized tubercles with soft yellow centres; parietal peritoneum normal. On the surface of the liver in an angle between two lobes there was a pea-sized nodule with fibrous walls and soft yellow contents; the nodule was adherent to the diaphragm. Liver substance normal. Spleen (?) enlarged, normal on section. Kidneys normal. The lungs with the exception of a small congested patch appeared normal. The ventral mediastinal glands showed a narrow line of caseation around the periphery; the xiphisternal glands, the size of millet seeds, were caseous throughout. Other lymphatic glands appeared normal.</p> <p>Microscopical Examination.—Smears from the spleen pulp and the nodule on the surface of the liver showed very numerous T.B., and there were numerous T.B. in the liver and lung.</p>

CHARTS AND POST-MORTEM NOTES.

In the following pages are given the Charts of Viruses P. IV, V, VI, VIII, IX, XI, XII, XIV, XXIX, XLI, and XLVI, and the full post-mortem notes of the larger animals inoculated with these viruses.

The remaining Viruses, P. I, II, III, VII, X, XIII, XV to XXVII inclusive, XXX to XXXIV inclusive, XXXVI to XL inclusive, XLII to XLIV inclusive, XLVII and XLIX to LXIII inclusive, were inoculated into rabbits and guinea-pigs only. These experiments are not charted; the results will be found in the tabular summaries on pages 177 to 206.

VIRUS P. IV.
(March 21st, 1905.)
SUBMAXILLARY GLAND.
CULTURE INOCULATIONS.

I.—JUNE 5TH, 1905.

The strain was derived from the original material, and had been in cultivation a total period of 76 days.
The culture used was the 5th generation, 20 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
308	Intrav.	1·0 mg.	K. 87 days	T. of lungs and kidneys, severe in the former.
307	Intrav.	0·1 mg.	K. 86 "	Similar to 308, but less severe in lungs.
310	Intrap.	10·0 mg.	K. 87 "	T. of peritoneum, omentum, and kidneys, not severe, and of lungs moderately severe.
312	Intrap.	1·0 mg.	K. 91 "	Local lesion. Slight T. of ungs and omentum.
314	Intrap.	0·1 mg.	D. 333 "	G. T.
309	Subcut.	10·0 mg.	K. 88 "	Local lesion. Slight T. of lungs.
311	Subcut.	1·0 mg.	K. 88 "	" " "
313	Subcut.	0·1 mg.	K. 88 "	" " "

II.—JULY 19TH, 1905.

The strain was derived from the original material, and had been in cultivation a total period of 120 days.
The culture used was the 7th generation, 20 days old.

CALF 312.
Subcutaneous.
Dose : 50 mg.
Killed when in fair health :
October 17, 1905.
90 days.

The local tumour was fibroid and caseous in the centre. The prescapular gland was largely composed of caseated tissue. In the lungs were moderately numerous transparent tubercles, and portions of the caudal lobes were consolidated (*see* P.M.). The suprarenals contained fairly numerous small tubercles. Several lymph glands contained one or more small foci.

CALF 314.
Subcutaneous.
Dose : 34 mg.
Killed : Dec. 1, 1905.
135 days.

Thin-walled cyst at seat of inoculation containing caseo-pus. The left prescapular gland was largely caseo-calcareous. The mesenteric glands contained minute calcareous tubercles; a single tubercle was seen in a thoracic gland.

CULTURE.

DECEMBER 4TH, 1905.
The strain was derived from the lung, and had been in cultivation a total period of 4½ months.
The culture used was the 4th generation, 20 days old.

FOWL 12.
Fed.
Dose : 32 mg.
Killed : 78 days.
Healthy.

CALF 356.
Subcutaneous.
Dose : 50 mg.
Killed : March 19, 1906.
105 days.

Fibroid local tumour with central cavity (containing thick caseo-pus) communicating externally by a sinus. In the left prescapular gland were some small caseous and calcareous tubercles.

CALF 358.
Subcutaneous.
Dose : 50 mg.
Killed : March 7, 1906.
93 days.

Abscess at seat of inoculation. Left prescapular gland contained a caseo-necrotic and calcified nodule. One or two minute tubercles were seen in one mediastinal and one portal gland, and in lung (?).

PIG 132.
Subcutaneous.
Dose : 1 mg.
Killed : April 5, 1906.
122 days.

Small caseo-calcareous tumour, with fibrous margin. A left inguinal gland contained six caseous slightly gritty nodules. The portal and ventral mediastinal glands contained calcareous or calcareo-caseous tubercles. About ten minute glassy tubercles were seen in the lung. The liver contained three small tubercles, and two coeliac glands one or more gritty foci.

PIG 134.
Fed.
Dose : 1 mg.
Killed : April 11, 1906.
128 days.

Both submaxillary glands contained small caseous gritty nodules. There was a grey tubercle in the lung Mesenteric glands normal.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
555	Intrav.	1·0 mg.	D. 88 days	T. of lungs and kidneys, very slight in latter. Small grey tubercles seen in principal muscles.
556	Intrap.	1·0 mg.	K. 276 "	Severe T. of lungs and thoracic glands. Slight T. of peritoneum. Moderately severe T. of kidneys.
557	Subcut.	50·0 mg.	D. 149 "	Local ulcer. One tubercle in spleen. Slight T. of liver and kidneys and lungs (rather more severe than in abdominal organs).

CULTURE.

MAY 14TH, 1906.
The strain was derived from the portal gland, and had been in cultivation a total period of 68 days.
The culture used was the 4th generation, 25 days old.

DOG 128.
Subcutaneous.
Dose : 50 mg.
Killed : 93 days.

Local ulcer. Foci in liver. Slight T. of lungs and bronchial glands.

CAT 74.
Subcutaneous.
Dose : 50 mg.
Killed : 92 days.

Local lesion. Slight T. of kidneys; one tubercle in lung.

JUNE 1ST, 1906.
The strain was derived from the prescapular gland, and had been in cultivation a total period of 3 months.
The culture used was the 5th generation, 21 days old

CALF 426.
Intramuscular.
Dose : 200 mg.
Died : June 30, 1906.
29 days.

Caseo-necrotic local tumour. The adjacent glands were firm, and infiltrated with a yellow network of necrosis. Moderate numbers of minute grey tubercles were seen in the lungs. There were numerous similar tubercles in the liver.

VIRUS P. IV.—*continued*.
(March 21st, 1905.)
CULTURE INOCULATIONS—*continued*.

III.—SEPTEMBER 20TH, 1905.

The strain was derived from the original material, and had been in cultivation a total period of 183 days.

The culture used was the 11th generation, 21 days old.

RABBITS.					Calf 350.		Pig 124.		Pig 126.	
					Subcutaneous.		Fed.		Subcutaneous.	
					Dose : 50 mg.		Dose : 1 mg.		Dose : 1 mg.	
					Killed : Dec. 19, 1905.		Killed : Jan. 16, 1906.		Killed : Jan. 12, 1906.	
					90 days.		118 days.		114 days.	
Number.	Method.	Dose.	Duration of Life.	Result.	Small fibro-caseous local tumour. Left prescapular gland showed $\frac{1}{3}$ of the cortex caseo-calcareous. The thoracic glands contained few minute foci. One tubercle was seen in a coeliac gland, and one in the lung.		Each submaxillary gland contained small caseous and slightly calcareous nodules. One mesenteric gland showed two tubercles, similar in character. One or two tubercles were seen in the lung, and in the portal and one bronchial gland.		Small caseating tumour, with fibrous margins. One left inguinal gland contained a caseated mass, other inguinal glands contained small caseous and calcareous tubercles and nodules; some were normal. There were a few tubercles in the portal and mesenteric glands.	
461	Intrav.	1.0 mg.	K. 90 days	Moderately severe T. of lungs and kidneys.	| CULTURE.				In the lungs was a moderate number of caseous and slightly gritty tubercles, up to 1 mm.	
463	Intrap.	10.0 mg.	D. 18 "	Early G. T.						
462	Intrap.	1.0 mg.	K. 90 "	Slight T. of peritoneum, kidneys, and lungs.						
464	Subcut.	10.0 mg.	K. 90 "	Local lesion. Slight T. of lungs. One tubercle in left kidney.						

APRIL 9TH, 1907.

The strain was derived from the prescapular gland, and had been in cultivation a total period of 487 days.

The culture used was the 14th generation, 21 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1294	Subcut.	25.0 mg.	K. 230 days	Caseous local lesion. Very slight T. of lungs and one kidney.
1295	Intrap.	1.0 mg.	D. 81 "	Tuberculosis of peritoneum, omentum, and kidneys not severe, and of lungs severe. Pseudo-tuberculosis of spleen and caecum.

CALF 312. Virus P. IV.

Subcutaneous inoculation of culture obtained from the original material of Virus P. IV.

Dose—50 milligrammes.

Date—July 19, 1905.

Weight at Inoculation—36.74 kilogrammes. [Age about 4 weeks.]

Killed when in fairly good health—October 17, 1905. [90 days after inoculation.]

Clinical History.

A week after inoculation there was a flattened slightly raised tumour 6.5 cm. in greatest diameter and a slightly enlarged prescapular gland.

The tumour increased in size, and four weeks after inoculation was prominent, rounded, and perceptibly softened in the centre.

Seven weeks after inoculation the tumour measured 12.5 by 7 by 2.5 cm., and was soft and fluctuant in the upper part; the prescapular gland was hard and measured 7.5 cm. in greatest length.

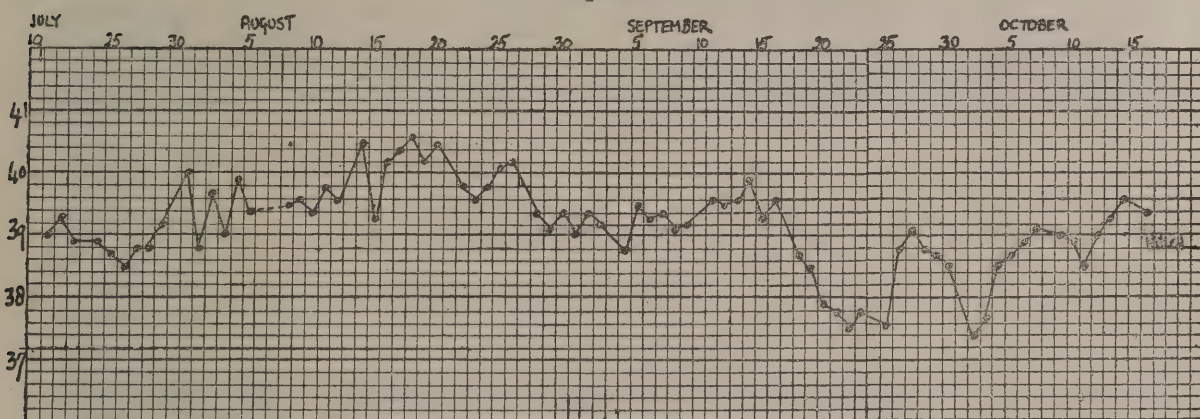
Subsequently both tumour and gland diminished in size. There was no change in the general health

until the fifth week when the respirations were seen to be distinctly quickened; they gradually increased in frequency, and for nearly three weeks were rapid and rather laboured, expiration ending in a short grunt; during this time there was frequent cough and the animal lost flesh. At one time the animal looked so ill that it appeared to be going to die.

The symptoms, however, abated, the respirations decreased in frequency and the general condition became much improved.

At the end of the experiment the respiration had not quite resumed its normal rate, but there was every indication that the animal was making a complete recovery.

Temperature.



Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

			Kilogrammes.
July 19, 1905	...	...	36.74
August 20, 1905	...	...	38.09
October 17, 1905	...	...	43.53

Total gain of weight.—6.80 kilogrammes.

The calf was weighed every week after inoculation; during the first six weeks the weight was practically stationary; subsequently there was a slight steady increase.

POST-MORTEM EXAMINATION.

Carcass.—In moderate condition.

Local Lesion.—The local tumour was small, thin, and lenticular in outline, measuring 9 by 6.5 by 2.5 cm.

On section it was composed of translucent fibrous tissue, showing in the centre irregular tracts of tough yellowish white caseated tissue; there were also, chiefly around the margins, irregular streaks and foci, slightly gritty from calcification.

In the middle of the upper part of the tumour there was a cavity the size of a walnut, filled with serous fluid containing small masses of broken down caseous tissue; the walls of the cavity were formed by caseated tissue, ragged and necrotic on the internal surface.

Left Prescapular Gland.—The left prescapular gland measured 6 by 3 by 2 cm. On section the greater part of the gland, about three quarters, was composed of firm homogeneous yellowish white caseated tissue, very slightly gritty from calcification. Around the margins of this mass, between it and the

capsule, was a narrow zone of more or less normal gland tissue, containing here and there irregular opaque foci, most of which were gritty. The rest of the gland was normal, except for one firm encapsulated caseous nodule containing gritty foci.

Left Prepectoral Glands.—The rounded gland, the size of a pea, contained two minute opaque yellow foci; the reniform gland was normal.

Right Prepectoral Glands, Right Prescapular Gland (5 by 2 by 1 cm.), Cervical Glands, and Axillary Glands.—Normal.

Abdomen.

Peritoneum.—There was a slight excess of fluid in the peritoneal cavity.

Omentum.—Normal.

Spleen.—The spleen weighed 56.6 grammes. It was normal on the surface and on section.

Liver.—The liver was normal on the surface. On section two or three minute opaque yellow foci were seen (fatty?)

Portal Glands.—One portal gland showed two or three minute opaque yellow foci in the cortex; another contained one similar point.

Kidneys.—The right kidney showed on the surface two minute grey points of a doubtful nature. The left was normal.

Suprarenals.—The left suprarenal body showed in the cortex fairly numerous tubercles, ranging in size from about 1 to 1.5 millimetre in diameter; the tubercles were grey, with slightly opaque centres.

The right suprarenal contained similar tubercles; in the centre of one was a minute calcareous grain.

Thorax.

Heart.—The endocardium of the right ventricle showed small patches of thickening, but no tubercles. Heart muscle and pericardium normal.

Pleura.—There was slight hypertrophy of the lymphatic fringes around the margin of the tendon on the right side, and small hard bodies could be felt at the base of some of them.

The pleura covering the ribs was normal.

Lungs.—The dorsal borders and posterior portions of the caudal lobes were firm, dark red and consolidated, and showed under the pleura a yellowish mottling. The yellow patches were situated in the centres of the small lobules, and showed around the margins fine arborisations, corresponding with the finer bronchioles. On section the solid lobules showed numerous small cavities (dilated bronchi) filled with tenacious muco-pus; some of the lobules were composed throughout of firm reddish tissue, mottled with opaque yellow foci; in the dorsal parts of the cephalic lobes there were a few consolidated lobules. The ventral parts of the caudal lobes, and almost the whole of the cephalic and right middle lobes were crépitant; on the surface of the former very numerous glistening transparent subpleural tubercles were seen; they projected slightly above the surface, the majority being about one millimetre in diameter. On section through these portions similar tubercles were seen in the depth; they were not, however, so distinct and apparently not so numerous as on the surface. In the cephalic lobes on the surface a few transparent tubercles were seen here and there and several

doubtful transparent grey points; on section tubercles were not definitely visible.

Left Bronchial Gland.—The left bronchial gland showed in the cortex a few minute whitish specks, some of which were just perceptibly gritty.

Right Bronchial Gland, Mediastinal Glands, Larynx, and Trachea.—Normal.

Alimentary Tract.

Pharynx, Tonsils, and Intestines.—Normal.

Mesenteric Glands.—Three mesenteric glands showed each a minute white speck.

All other lymphatic glands were normal.

Testes.—Normal.

Microscopical Examination.

Smears from:—

Lung (muco-pus, two smears).—Numerous tubercle bacilli.

Left Prescapular Gland.—Moderately numerous tubercle bacilli.

Right Prepectoral Gland, Mesenteric Gland, Left Suprarenal Body, Right Suprarenal Body, and Portal Gland. } A few tubercle bacilli.

Left Bronchial Gland, Liver, and Kidney. } No tubercle bacilli.

CALF 314. Virus P. IV.

Subcutaneous inoculation of culture obtained from the original material of Virus P. IV.

Dose—34 milligrammes.

Date—July 19, 1905.

Weight at Inoculation—33·55 kilogrammes. [Age about 5 weeks.]

Killed—December 1, 1905. [135 days after inoculation.]

[The calf was killed because it was suffering from paralysis of the hind legs (due to caries of the 12th dorsal vertebra). The general condition was good.]

Clinical History.

Seven days after inoculation there was an oval swelling measuring 5 by 4 cm., and a slightly enlarged prescapular gland. The swelling increased in size and on the 30th day measured 10 by 6 cm. and was distinctly softened; the gland was moderately enlarged, measuring 8 by 5 cm.

Subsequently the tumour was converted into a thin-walled prominent pendulous cyst, 15 cm. in length by 10 cm. in breadth. The prescapular gland diminished in size and became irregular and nodular in outline. An enlarged prepectoral gland was felt during life. There was no obvious change in the general condition of the animal until November 29th, when it was found lying on its side and unable to rise from the ground, the hind legs being rigid and evidently paralysed. On the next day the calf was in much the same condition and, since it was unable properly to take nourishment, was killed.

Temperature.—On the 10th day after inoculation the temperature rose suddenly to 40·4° C., but fell to the normal two days later. During the remaining period of the experiment the temperature was a little raised, and at the same time irregular. The maximum range of variation within a period of 4 months was 1·6° C. (38·1° C.—39·7° C.).

Tuberculin Test.—November 17th, 1905. [121 days after inoculation.] Positive reaction. Rise of temperature, 1·3° C.

Weights.

	Kilogrammes.			
July 19, 1905	33·55
August 15, 1905	28·57
October 18, 1905	44·44
November 21, 1905	39·45
December 1, 1905	46·25

Total gain of weight during experiment.—12·69 kilogrammes.

POST-MORTEM EXAMINATION.

The carcass was in fair condition.

Local Lesion.—At the seat of inoculation there was a tense fluctuating tumour, measuring 15 by 10 by 9 cm. and weighing with skin 793 grammes. On section it was a thin-walled cyst, filled with thick creamy yellow caseo-pus; the internal surface was pale and granular, and numerous calcareous grains were felt on passing the fingers over it; the cavity was crossed by one thick fibrous band and several slender ones.

Left Prescapular Gland.—The left prescapular gland weighed a little over 28 grammes, and measured 6·5 by 4 by about 2·5 cm. in greatest thickness. It was irregular and nodular externally, and showed on section the greater part of the cortex replaced by calcareo-caseous masses, containing cavities filled with light brownish or creamy caseo-pus; the medulla was normal.

Left Prepectoral Glands.—The spherical gland, 14 millimetres in diameter, showed about three quarters of the substance composed of dense calcareo-caseous tissue; the gland was very indurated and the capsule thickened. The reniform gland was normal.

Cervical Glands.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—The right cephalic and right middle lobes showed some dark red patches of collapse; otherwise the lungs were perfectly normal to the naked eye.

Trachea.—Normal.

Thoracic Glands.—The caudal mediastinal gland contained one yellow pinhead-sized tubercle. Other mediastinal and the bronchial glands were normal.

Heart.—Normal.

Abdomen.

Peritoneum and Omentum.—Normal.

Large Intestine and Small Intestine.—Normal.

Mesenteric Glands.—The mesenteric glands were normal in size; they showed in the cortices minute yellow calcareous tubercles; these were most numerous in the terminal glands.

Spleen.—The spleen weighed 70·8 grammes, it was normal in size and general appearance.

Liver, Gall Bladder, and Portal Glands.—Normal.

Kidneys and Suprarenal Bodies.—Normal.

Bladder.—The bladder was greatly distended.

All the lymphatic glands not hitherto mentioned were normal.

Tongue, Tonsils, Pharynx, Larynx.—Normal.

Eyes.—Normal.

Vertebral Column.—On cutting into the spinal canal, the cord was found to be compressed at the level of the twelfth dorsal vertebra between a rounded projection of new formed bone, arising from the upper surface of the body of the vertebra, and by a recent blood clot between the laminae and the periosteum.

Section through the vertebra showed most of the cancellous tissue of the body hollowed out by rarefying osteitis, the floor of the cavity being formed by the anterior vertebral ligament, the roof chiefly by the mass of new formed bone, and the sides by the remains of the cancellous tissue. There was no sign of caseation or suppuration in the bone surrounding the cavity. The cord showed a well marked constriction, apparently recent; there was much gelatinous oedema in the posterior part of the canal between the periosteum and dura mater

CALF 350. Virus P. IV.

Subcutaneous inoculation of culture derived from original material of Virus P. IV.

Dose—50 milligrammes.

Date—September 20, 1905.

Weight at Inoculation—33·10 kilogrammes. [Age about 4 weeks.]

Killed when in good health—December 19, 1905. [90 days after inoculation.]

Clinical Notes.

Ten days after inoculation on the left side of the neck a slight local thickening could be felt; the adjacent prescapular gland was slightly enlarged.

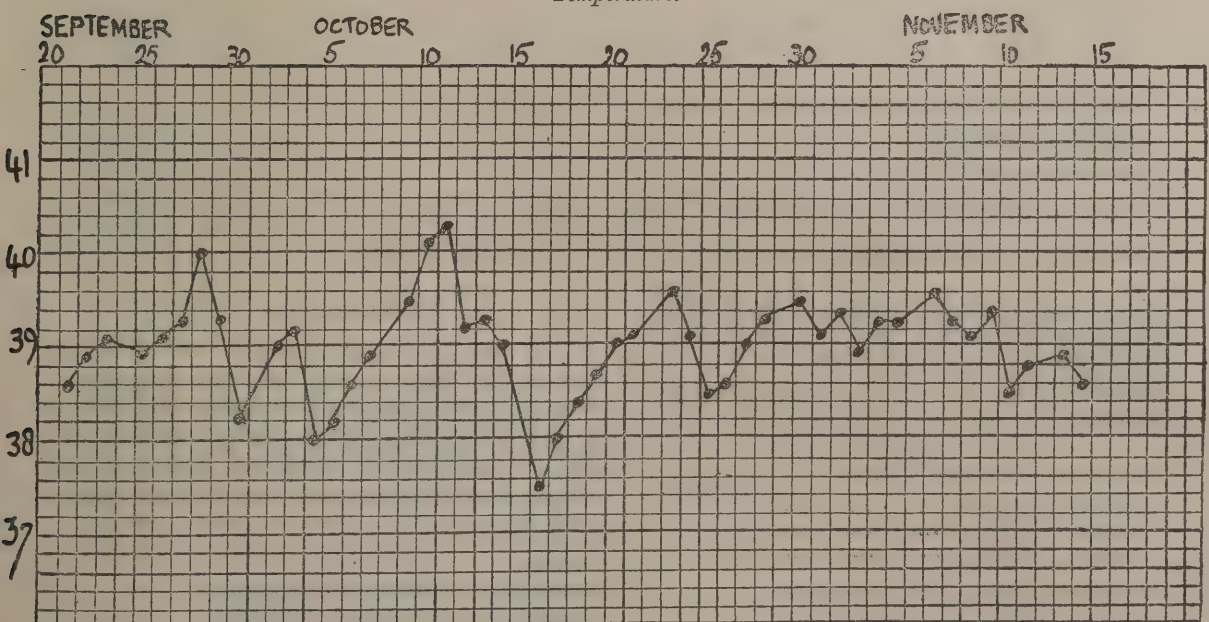
After three weeks a small slightly raised tumour had developed, which measured 6·5 by 5 cm.; the

prescapular gland was still slightly enlarged, 5·5 cm. in length.

No further change of any importance took place in the local conditions.

The calf was killed on the 90th day. It had remained well during the experiment.

Temperature.



From November 15 to December 19 the temperature was fairly normal, though somewhat irregular. The maximum range of variation was between 38·0 and 39·3° C.

Tuberculin Test.—November 19, 1905 [58 days after inoculation]. Positive reaction. Rise of temperature 1·8° C.

Weights.			Kilogrammes.
September 20, 1905	...	...	33·10
December 19, 1905	...	...	54·87
<i>Total gain of weight.</i> —21·76 kilogrammes.			
<i>Rate of gain per week.</i> —1·67 kilogrammes.			

POST-MORTEM EXAMINATION.

Carcass.—Carcass in moderate condition.

Local Lesion.—In the subcutaneous tissues on the right side of the neck there was a small tumour 6 by 4 by about 1·5 cm. in greatest thickness; on section it was composed of dense fibrous tissue containing two small cavities filled with buff coloured caseo-pus, and numerous small irregular gritty caseous nodules, most of which were softened; the skin and muscles were adherent but not infiltrated.

Right Prescapular Gland.—The right prescapular gland measured 5 by 3 cm. by about 2 cm. On section it showed rather more than a third of the cortex dense caseous and calcareous; the rest of the gland was normal.

Left Prescapular Gland.—The left prescapular gland measured 4·5 by 2·5 cm. by about 1·5 cm. and was normal on section.

Prepectoral Glands.—Right and left prepectoral glands normal.

Cervical Glands.—Right and left cervical glands normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were normal in general appearance; in the left caudal lobe under the pleura there was a grey almost transparent miliary tubercle; under the pleura in all the lobes there was a number of very minute dark grey points of a doubtful nature; on section nothing abnormal was seen.

Trachea.—Normal.

Bronchial and Mediastinal Glands.—The bronchial and mediastinal glands were not enlarged. The caudal gland showed in the cortex a few minute yellow foci, some of which were appreciably gritty.

The gland above the bifurcation of the trachea, the bronchial and infratracheal glands, showed similar yellow foci, in small number.

The ventral mediastinal glands were normal.

Heart.—Normal.

Abdomen.

Peritoneum and Omentum.—Normal.

Small Intestine, Large Intestine, Gastric Glands, Mesenteric Glands, and Colic Glands.—Normal.

Spleen.—The spleen weighed 141 grammes; it was normal on the surface and on section.

Liver, Gall Bladder, Portal Glands, Kidneys, and Suprarenal Bodies.—Normal.

Coeliac Glands.—One coeliac gland contained a small irregular gritty tubercle; the others were normal.

Lumbar Glands and Iliac Glands.—Normal.

Testes.—Normal.

Special Glands.

Precrural, Pudic, Gluteal, Ischiatic, Popliteal, Submaxillary, Parotid, and Retropharyngeal.—Normal.

Tongue, Tonsils, and Larynx.—Normal.

Eyes.—Normal.

Microscopical Examinations. Smear preparations.

Prescapular Gland.—Numerous tubercle bacilli many long and beaded forms.

Coeliac Gland.—Two tubercle bacilli found.

Mediastinal Gland.—No tubercle bacilli.

PIG 124. Virus P. IV.

Fed with culture derived from original material of Virus P. IV.

Dose—1 milligramme.

Date—September 20, 1905.

Weight at Inoculation—10·0 kilogrammes. [Age 7 weeks.]

Killed when in good health—January 16, 1906. [118 days after feeding.]

Clinical Notes.—The pig remained in good health during the experiment.

Temperature.—Normal throughout.

Tuberculin Test.—The pig was not tested subsequent to inoculation.

Weights.			Kilogrammes.
September 26, 1905	...	...	10·0
October 18, 1905	...	...	10·88
January 16, 1906	...	...	33·55
<i>Total gain of weight.</i> —23·55 kilogrammes.			

POST-MORTEM EXAMINATION.

Carcass.—In good condition.

Alimentary Tract.

Tongue, Pharynx, Tonsils.—Normal.

Submaxillary Glands.—The submaxillary glands, one on each side, contained a moderate number of yellow cheesy caseous nodules, slightly gritty from calcification. They were irregular in outline, and shelled out easily from the surrounding gland tissue; in the gland on the left side they ranged in size from a pin's head to that of a wheat grain; in that on the right side they were a little larger, up to that of a pea.

Retropharyngeal Glands, Cervical Glands.—Normal.

Stomach, Small Intestine, Large Intestine, Gastric Glands.—Normal.

Mesenteric Glands.—A gland in the anterior part of the mesentery contained two irregular caseous gritty

tubercles, the largest 1·5 millimetre in greatest diameter; other mesenteric glands were normal.

Ileo-Colic Glands, Colic Glands.—Normal.

Abdomen.

Omentum, Peritoneum, Spleen, Liver, Gall Bladder.—Normal.

Portal Glands.—One portal gland contained two pearly white spherical tubercles, each less than a pin's head in size.

Coeliac Glands, Kidneys, Suprarenal Bodies.—Normal.

Thorax.

Heart, Pleura.—Normal.

Lungs.—In the right cephalic lobe of the lung there was a subpleural grey tubercle, the size of a pin's head, with a yellow gritty centre. In the substance of the left caudal lobe there was a caseo-calcareous tubercle 1·5 millimetre in diameter. The rest of the lung was normal.

Bronchial Glands.—On the right side, in the angle between the right anterior bronchus and the trachea, a gland contained two yellow pinhead-sized caseous tubercles, slightly gritty from calcification. The other bronchial glands were normal.

Dorsal Mediastinal Glands, Ventral Mediastinal Glands.—Normal.

Various Lymphatic Glands.

Prescapular Glands, Prepectoral Glands, Precrural Glands, Iliac Glands, Lumbar Glands.—Normal.

Microscopical Examination.

Lung Tubercle.—No tubercle bacilli seen.

Tubercle from Bronchial Gland.—No tubercle bacilli seen.

Tubercle from Portal Gland.—No tubercle bacilli seen.

FIG 126. Virus P. IV.

Subcutaneous inoculation of culture derived from original material of Virus P. IV.

Dose—1 milligramme.

Date—September 20, 1905.

Weight at Inoculation—8·5 kilogrammes. [Age 7 weeks.]

Killed when in good health—January 12, 1906. [114 days after inoculation.]

Clinical Notes.

A very small swelling developed at the seat of inoculation in the abdominal wall, and the nearest inguinal gland became slightly enlarged.

Temperature.—The day after inoculation the temperature rose to 40·0° C. It quickly fell to normal. On the 13th day the temperature again rose, and reached a maximum of 39·8° C., returning to normal within a week. Subsequently the temperature remained normal.

Tuberculin Test.—The pig was not tested subsequent to inoculation.

Weights.

			Kilogrammes.
September 26, 1905	...	...	8·5
October 18, 1905	...	...	10·43
January 12, 1906	...	...	27·66

Total gain in weight during experiment.—19·16 kilogrammes.

POST-MORTEM EXAMINATION.

Carcass.—In good condition.

Local Lesion.—At the seat of inoculation near the umbilicus there was a nodule the size of a broad bean composed of tough yellowish white caseated tissue, gritty around the margins and softened in the centre, surrounded by a thin capsule of fibrous tissue; the skin was not adherent.

Inguinal Glands.—The glands on the right side were not enlarged; the one nearest the local lesion contained a pea-sized caseous slightly gritty nodule, with a mulberry-like outline, and half-a-dozen caseous nodules, the largest the size of a hemp seed; the nodules shelled out easily from the gland substance; the other glands in this group were normal.

On the left side the gland nearest the local lesion

was a little enlarged and showed about half its substance replaced by an irregular mass of firm caseated tissue slightly gritty from calcification; a pea-sized gland near it contained a small caseous nodule and another smaller gland a caseous tubercle; other glands in this group were normal.

Abdomen.

Iliac Glands, Ilio-Sacral Glands, Lumbar Glands, Omentum and Peritoneum.—Normal.

Spleen.—The spleen showed on the convex surface a patch of cicatricial thickening; otherwise normal.

Liver.—Normal.

Portal Glands.—One portal gland contained about nine yellowish tubercles, the largest the size of a pin's head; another contained three or four similar tubercles.

Kidneys, Suprarenal Bodies.—Normal.

Thorax.

Heart, Diaphragm, Pleura.—Normal.

Lungs.—The lungs were crepitant throughout and contained a moderate number of evenly distributed shotty tubercles ranging in size from about 0·5 to 1 millimetre in diameter; the tubercles were yellow caseous and slightly gritty and had narrow grey margins.

Dorsal Mediastinal, Bronchial Glands, Larynx, and Trachea.—Normal.

Alimentary Tract.

Tongue, Pharynx, Tonsils.—Normal.

Stomach, Intestines.—Normal.

Submaxillary, Retro-pharyngeal and Cervical Glands.—Normal.

Mesenteric Glands.—There were a few caseous gritty tubercles (largest 1 millimetre in diameter) in the glands in the anterior part of the mesentery and two in those in the posterior part.

Ileo-Colic Glands.—Normal.

Prescapular Glands, Prepectoral Glands, Coeliac Glands.—Normal.

Microscopical Examinations.

Portal Gland.—One tubercle bacillus seen.

Mesenteric Gland.—No tubercle bacilli.

Animal Inoculated.

A guinea-pig inoculated with an emulsion from the spleen died in 18 days showing no evidence of tuberculosis.

CALF 356. Virus P. IV.

Subcutaneous inoculation of culture derived from the lung of Calf 312.

Dose—50 milligrammes.

Date—December 4, 1905.

Weight at Inoculation—56·69 kilogrammes. [Age about 12 weeks.]

Killed when in good health—March 19, 1906. [105 days after inoculation.]

Clinical Notes.

Eleven days after inoculation on the left side of the neck there was a slightly raised swelling measuring 10 by 7·5 cm. and about 2 cm. thick. The adjacent prescapular gland was about 7 cm. in length.

On the 32nd day there was a prominent fluctuating tumour at the seat of inoculation, measuring 14 by 7·5 cm. The prescapular gland was enlarged, 6 cm. in length.

On the 80th day the tumour was cystic, measuring 11 by 8 by about 5 cm.

On the 103rd day the tumour burst, discharging caseo-pus.

On the 105th day the calf was killed. It had shown no sign of ill-health during the experiment.

Temperature.—On the tenth day the temperature rose to 40·4° C. It remained high for ten days, and then returned to the normal. The temperature subsequently remained normal until the end of the experiment.

Tuberculin Test.—February 2nd, 1906, 60 days after inoculation. Positive reaction. Rise of temperature, 1·5° C.

Weights.

			Kilogrammes.
December 5, 1905	...	...	56·69
January 25, 1906	...	...	72·56
February 21, 1906	...	...	85·71
March 19, 1906	...	...	93·42

Total gain of weight during experiment. — 36·73 kilogrammes.

Average rate of gain per week.—2·44 kilogrammes.

POST-MORTEM EXAMINATION.

Carcass.—In very good condition.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a raised tumour measuring about 9 by 6·5 by 4 cm. At the upper extremity the skin showed a sinus, the diameter of a crow-quill, the outer opening of which was concealed by a mass of dried discharge. On section the tumour was composed of dense white fibrous tissue containing a few scattered yellow gritty tubercles; just under the skin there was an irregular cavity 4·5 cm. in greatest diameter filled with thick yellow caseo-pus; the cavity was lined with reddish granulation tissue and was crossed by several thick fibrous trabeculae; this cavity communicated externally by the sinus mentioned above; the skin external to it was very thick except at one part where it appeared to be just on the point of breaking down.

Left Prescapular Gland.—The left prescapular

gland measured 6·5 by 3 by nearly 1·5 cm., and was only slightly larger (thicker) than the right; on section it showed in the cortex a number of yellow calcareous foci and a few soft whitish caseous tubercles, the largest a little more than 1 mm. in diameter; there were besides two small nodules, the largest the size of a split pea, composed of brownish translucent tissue and calcareous particles; the gland tissue was normal in appearance.

Right Prescapular Gland.—Normal.

Prepectoral and Cervical Glands on both sides were normal.

Thorax.

Heart.—Normal.

Pleura.—Normal.

Lungs.—Under the pleura a few minute scattered grey foci of a doubtful nature were seen (a smear made from one showed no tubercle bacilli); otherwise the lungs were perfectly normal.

Bronchial and Mediastinal Glands.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen (311 grammes).—Normal.

Liver.—Normal.

Portal Glands.—Normal.

Kidneys.—Normal.

Suprarenal Bodies.—Normal.

Tonsils, Pharynx, Larynx, and Trachea.—Normal.

Intestines.—Normal.

Testes.—Normal.

Eyes.—Normal.

Special Lymphatic Glands.

Parotid, Submaxillary, Pharyngeal, Axillary, Renal, Lumbar, Mesenteric, Gastric, Colic, Iliac, Preaural, Popliteal, Gluteal, Pudic, and Ischiatic Glands.—Normal.

Microscopical Examination.

(Smear Preparations.)

Prescapular Gland (soft tubercle).—A few tubercle bacilli seen.

Lung (grey focus).—No tubercle bacilli seen.

CALF 358. Virus P. IV.

Subcutaneous inoculation of culture derived from the lung of Calf 312.

Dose—50 milligrammes.

Date—December 4, 1905.

Weight at Inoculation—63·50 kilogrammes. [Age about 14 weeks.]

Killed when in good health—March 7, 1906. [93 days after inoculation.]

Clinical Notes.

Eleven days after inoculation on the left side of the neck there was a flat swelling measuring 9 by 7·5 cm. The adjacent prescapular gland was slightly enlarged, 6·5 cm. in length.

The swelling developed into a prominent softened tumour which on the 32nd day measured 9·5 by 7·5 cm.; the prescapular gland was enlarged, 7·5 cm. in length.

On the 80th day the tumour was tense, prominent and cystic, measuring 9 by 7·5 cm.; the prescapular gland had diminished in size and now measured about 5 cm. in length.

On the 93rd day after inoculation the calf was killed. It had remained well during the experiment.

Temperature.—There was a slight rise of temperature on the 11th day after inoculation which lasted 11 days and reached a maximum of 39·8° C. Subsequently the temperature remained normal.

Tuberculin Test.—February 2, 1906, 60 days after inoculation. Slight reaction. Rise of temperature 0·6° C.

Weights.

			Kilogrammes.
December 5, 1905	...	...	63·50
January 25, 1906	...	...	90·70
February 21, 1906	...	...	102·94
March 7, 1906	...	...	108·84

Total gain of weight during experiment.—45·34 kilogrammes.

Average rate of gain per week.—3·49 kilogrammes.

POST-MORTEM EXAMINATION.

General Condition.—Good.

Local Lesion.—At the seat of inoculation, on the left side of the neck, there was a tense egg-shaped fluctuant swelling measuring 9 by 6·5 by 5 cm.

On section it was found to be a thin-walled cyst filled with thick tenacious caseo-pus and yellow watery fluid; the walls of the cyst were formed by fibrous tissue lined internally with pale granulation tissue; the cavity was crossed by several fibrous trabeculae.

Left Prescapular Gland.—The left prescapular gland measured 5 by 2·5 by about 1·5 cm., and was only slightly thicker than the right. On section the cortex along the convex margin showed an irregular patch of dense tough caseo-necrotic tissue very gritty around the margins. The capsule of the gland

external to the caseous mass was slightly thickened, and around the margins was a narrow zone of brownish translucent tissue; the latter and the peripheral parts of the caseated tissue were very gritty from calcification.

The right Prescapular, the right and left Prepectoral and Axillary Glands were normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs showed a few minute grey foci of a doubtful nature.

Thoracic Glands.—A dorsal mediastinal gland anterior to the bifurcation of the trachea contained a greyish white spherical tubercle about 1 mm. in diameter. Other thoracic glands were normal.

Heart.—Normal.

Abdomen.

Peritoneum and Omentum.—Normal.

Spleen.—Normal.

Liver.—Normal.

Portal Glands.—One portal gland seemed a little firmer than normal, and showed on section in the cortex slightly opaque greyish-white foci in some of which were yellow points; they were not perceptible to the touch.

Kidneys.—Normal.

Suprarenal Bodies.—Normal.

Renal, Lumbar, and Iliac Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Intestines.—Normal.

Mesenteric Glands.—Normal.

Various Lymphatic Glands.

Submaxillary, Pharyngeal, Parotideal, Hyoid.—Normal.

Precural, Popliteal, Gluteal, Ischiatic, Pudic.—Normal.

Microscopic Examinations.

Emulsion of left Prescapular Gland.—Tubercle bacilli in moderate numbers.

Tubercles from Portal Gland.—(1) No tubercle bacilli seen. (2) One tubercle bacillus seen.

PIG 132. Virus P. IV.

Subcutaneous inoculation of culture derived from the lung of Calf 312.

Dose—1 milligramme.

Date—December 4, 1905.

Weight at Inoculation—26·0 kilogrammes. [Age about 15 weeks.]

Killed when in good health—April 5, 1906. [122 days after inoculation.]

Clinical Notes.

A small tumour developed at the seat of inoculation in the abdominal wall, and the adjacent inguinal gland became slightly enlarged.

The pig showed no sign of illness during the experiment.

Temperature.—Normal throughout.

Tuberculin Test.—February 2, 1906. [61 days

after inoculation.] Positive reaction. Rise of temperature, 2·3° C.

Weights.

			Kilogrammes.
December 6, 1905	...	...	26·0
April 5, 1906	...	...	68·47

Total gain of weight during experiment.—42·47 kilogrammes.

Average rate of gain per week.—2·44 kilogrammes.

POST-MORTEM EXAMINATION.

Carcass.—In very good condition.

Local Lesion.—At the seat of inoculation a little to the left of the umbilicus there was a firm nodule, slightly adherent to the skin, 2·2 cm. in length and about 1·5 cm. in diameter; on section it was composed of somewhat tough yellow caseous material, slightly gritty from calcification and at one part beginning to soften, surrounded by a thin fibrous capsule.

Inguinal Glands.—On the left side the glands nearest the local lesion contained six caseous slightly gritty nodules ranging in size from 4 to 8 mm. in diameter; each nodule had a thin capsule of fibrous tissue; the caseous material in each case was friable but not softened and could be readily shelled out in a mass from its surrounding capsule; other glands in this group were normal.

On the right side the inguinal glands were normal.

Precrural Glands.—Normal.

Iliac and Lumbar Glands.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—Normal.

Liver.—The liver showed under the capsule two small tubercles (largest about 1 mm.) with grey margins and opaque yellow centres; in the depth of the liver substance one minute yellowish white spherical body was seen.

Portal Glands.—The portal glands were not enlarged, and contained discrete yellow calcareous

tubercles, some very irregular in outline, the largest about 1 mm. in diameter; they very readily shelled out from the surrounding gland tissue which was perfectly normal in appearance.

Kidneys.—Normal.

Suprarenal Bodies.—Normal.

Thorax.

Heart and Pleura.—Normal.

Lungs.—The lungs were normal in general appearance; they showed just under the pleura altogether about ten minute tubercles each about 0·5 mm. in diameter; the tubercles were glassy and very slightly opalescent in the centre.

Bronchial and Mediastinal Glands.—Each bronchial gland showed on section one minute white point; they were otherwise normal. The inter-bronchial, infra-tracheal, and dorsal mediastinal glands were normal.

Two ventral mediastinal glands were slightly enlarged; one contained a pea-sized gritty cheesy nodule; the other contained a similar but larger mass which almost completely replaced the gland substance; each mass was surrounded by a thin fibrous capsule.

Larynx and Trachea.—Normal.

Alimentary Tract.

Tongue, Tonsils, and Pharynx.—Normal.

Intestines.—Normal.

Gastric Glands.—Normal.

Mesenteric and Colic Glands.—Normal.

Uterus.—Normal.

Thyroid Body.—Normal.

Special Lymphatic Glands.

Coeliac Glands.—The largest gland contained a few minute yellowish white gritty foci; another smaller gland contained one similar focus; the rest were normal.

Submaxillary, Pharyngeal, Cervical, Prescapular, Prepectoral, and Precrural Glands.—Normal.

FIG 134. Virus P. IV.

Fed with culture derived from the lung of Calf 312.

Dose—1 milligramme.

Date—December 4, 1905.

Weight at Inoculation—20·25 kilogrammes. [Age about 15 weeks.]

Killed when in good health—April 11, 1906. [128 days after feeding.]

Clinical Notes.

The pig remained in good health during the experiment.

Temperature.—Normal.

Tuberculin Test.—February 2, 1906. [61 days after inoculation.] Positive reaction. Rise of temperature, 1·3° C.

Weights.

			Kilogrammes.
December 6, 1905	...	...	20·25
April 10, 1906	...	...	63·03

Total gain of weight during experiment.—42·78 kilogrammes.

Average rate of gain per week.—2·35 kilogrammes.

POST-MORTEM EXAMINATION.

Body in good condition.

Alimentary Tract.

Tongue, Tonsils and Pharynx.—Normal.

Submaxillary Glands.—The left submaxillary gland contained about half a dozen caseous gritty nodules, the largest nearly 3 mm. in diameter; each nodule was surrounded by a delicate capsule of fibrous tissue from which it could be readily shelled.

The right submaxillary gland contained two similar caseous nodules and a few discrete yellow gritty tubercles, irregular in outline.

Pharyngeal and Cervical Glands.—Normal.

Stomach.—Normal.

Small Intestine.—Normal.

Large Intestine.—Normal.

Gastric, Mesenteric, Ileo-Colic and Colic Glands.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—Normal.

Liver.—In the substance of the liver under the capsule on the anterior surface there was a whitish fibrous nodule, the size of a pea; the liver substance around it showed an increase in interstitial connective tissue; with this exception the liver was normal.

Portal Glands.—Normal.

Kidneys, Suprarenal Bodies.—Normal.

Thorax.

Heart and Pleura.—Normal.

Lungs.—The lungs were crepitant throughout and collapsed normally; in the right caudal lobe under the pleura there was one grey almost transparent tubercle the size of a pin's head; with this exception the lungs were normal.

Larynx and Trachea.—Normal.

Bronchial and Dorsal and Ventral Mediastinal Glands.—Normal.

Various Lymphatic Glands.

Prescapular, Prepectoral, Precurral, Inguinal, Iliac and Lumbar Glands.—Normal.

Special Organs.

Thyroid Body, Testes and Urinary Bladder.—Normal.

Microscopical Examination.

(Smear Preparation.)

Submaxillary Gland Nodule.—No tubercle bacilli.

Animal Inoculated.

A guinea-pig inoculated with an emulsion made from the nodule in the liver remained free from tuberculosis.

CALF 426. Virus P. IV.

Intramuscular inoculation of culture derived from prescapular gland of Calf 358 (injected with culture from Calf 312).

Dose—200 milligrammes.

Date—June 1, 1906.

Weight at Inoculation—29·02 kilogrammes. [Age about 8 weeks.]

Died—June 30, 1906. [29 days after inoculation.]

Clinical Notes.

The calf was not in very good condition when inoculated; it had suffered since its arrival at Walpole from severe diarrhoea.

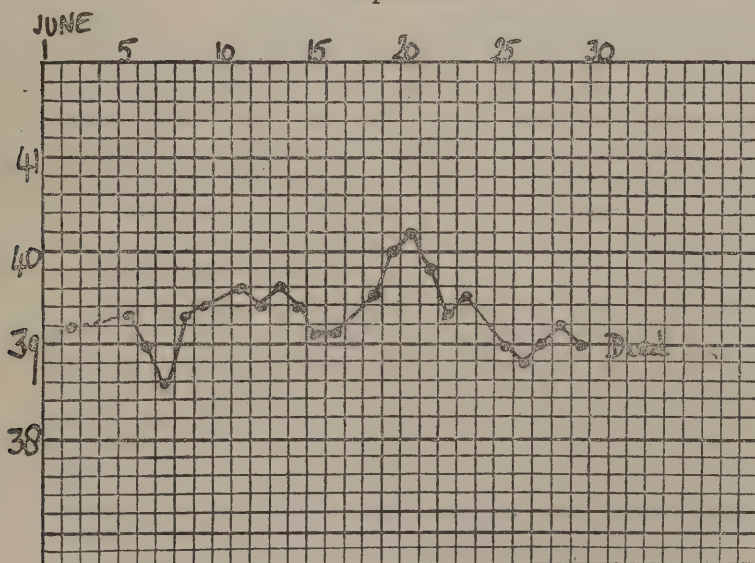
Five days after inoculation on the left side of the neck a firm deep seated tumour had developed, measuring about 6·5 cm. in greatest diameter; the

skin was moveable over it. The adjacent prescapular gland was slightly enlarged.

On the 20th day the tumour was about 9 cm. in diameter; the prescapular gland was slightly enlarged; the prepectoral gland was the size of a pea.

On the 29th day the calf died. It had been in poor condition throughout the experiment; its appetite was moderately good, but there was almost constant diarrhoea.

Temperature.



Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

	Kilogrammes.
June 1, 1906...	29·02
June 5, " ...	26·30
June 25, " ...	27·66

Total loss of weight during experiment.—1·36 kilogrammes.

POST-MORTEM EXAMINATION.

Carcass.—In very poor condition.

Local Lesion.—In the muscles on the left side of the neck there was an ill-defined swelling, measuring roughly 10 by 7·5 by 2·5 cm.; the skin was freely moveable over it.

On section the muscles were found to contain a mass of yellow caseo-necrotic tissue, the margins of which were not definitely circumscribed; in the

thicker part of the mass there was an egg-shaped cavity, 5 cm. in greatest diameter, filled with clear yellow serous fluid; the internal wall was formed by soft shreddy necrotic material.

Left Prescapular Gland.—The left prescapular gland was enlarged and measured 6 by 3 cm. by about 2 cm.; on section the cortex was firmer than normal, and in places indurated, and showed a fine yellow network of necrosis, more definite in some parts of the cortex than in others.

Right Prescapular Gland.—The right prescapular gland measured 4 by 2 by 1 cm., and was normal on section.

Prepectoral Glands.—On the left side there were two enlarged glands, one the size of a broad bean, the other a little smaller; both were indurated and showed on section a fine yellow network in the cortices. On the right side the glands were normal.

Cervical Glands.—Two lower cervical glands on the left side were enlarged and on section resembled the left prepectoral glands. On the right side the glands were normal.

A gland just within the entrance to the thorax was enlarged and a little firmer than normal and showed in the cortex a few very early foci of necrosis.

Thorax.

Lungs.—The lungs collapsed normally and showed, chiefly in the left lung, small irregular patches of collapse; scattered evenly throughout the substance of the lungs were moderately numerous minute dark grey tubercles which projected slightly from the cut surface; here and there was seen a larger tubercle with a slightly opaque centre.

The Bronchial and Mediastinal Glands appeared normal.

Heart and Pleura—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—The spleen was normal in size and appeared normal on section.

Liver.—The liver was normal on the surface; on section the substance showed numerous minute greyish white tubercles.

Portal Glands.—Normal.

Kidneys.—The capsules of the kidneys stripped badly; the cortex was pale and diminished in thickness; the kidney substance generally was tough and fibroid; no tubercles were seen.

Suprarenal Bodies.—Normal.

Renal, Lumbar, and Iliac Glands.—Normal.

Alimentary Tract.

Pharynx, Tonsils.—Normal.

Intestines.—Normal.

Mesenteric, Gastric, and Colic Glands.—Normal.

Various Lymphatic Glands.

Pharyngeal, Parotid, Submaxillary, Axillary, Coeliac, Preaural, Popliteal, Pudic, Ischiatic, and Gluteal Glands.—Normal.

VIRUS P. V.
(April 18, 1905.)

BRONCHIAL GLAND.

CULTURE INOCULATIONS, AUGUST 30, 1905.

The strain was derived from the original material and had (been in cultivation)
a total period of 134 days.

The culture used was the 7th generation, 20 days old.

CALF 336.
Subcutaneous.
Dose : 50 mg.
Died : Sept. 28, 1905.
29 days.
P.M.—General Tuberculosis, severe.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
397	Intrav.	0.1 mg.	D. 21 days	G. T.
394	Intrap.	1.0 mg.	D. 21 "	G. T.
399	Intrap.	1.0 mg.	D. 13 "	G. T.
398	Intrap.	0.1 mg.	D. 29 "	G. T.
400	Intrap.	0.01 mg.	D. 30 "	G. T.
395	Subcut.	1.0 mg.	D. 88 "	G. T.
396	Subcut.	0.1 mg.	D. 58 "	G. T.

CALF 336. Virus P. V.

Subcutaneous inoculation of culture derived from the original material of Virus P. V.

Dose—50 milligrammes.

Date—August 30, 1905.

Weight at Inoculation—29.48 kilogrammes. [Age about 6 weeks.]

Died—September 28, 1905. [29 days after inoculation.]

Clinical Notes.

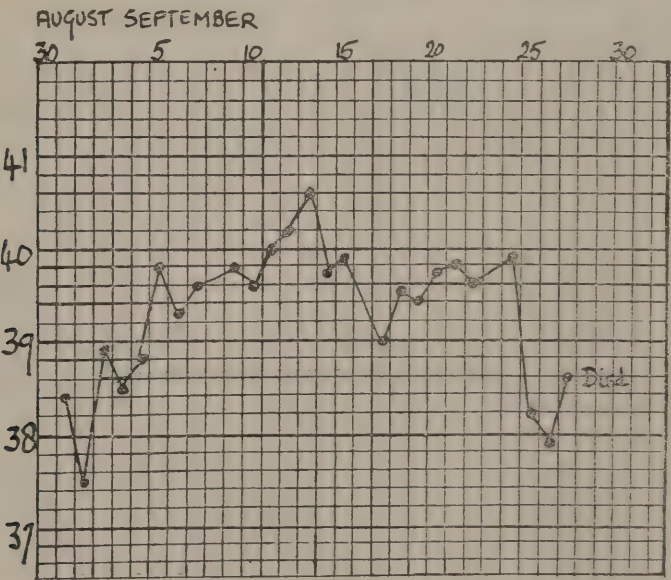
Seven days after inoculation on the left side of the neck there was a flattened local thickening, infiltrating the muscles, measuring 7.5 by 6.5 cm.; there was slight oedema in the loose tissues around the lower extremity. The prescapular gland was very slightly enlarged.

On the 23rd day a tumour had developed at the seat of inoculation, which measured 11.5 by 9 cm. and was

not more than 2 cm. thick. The prescapular gland was enlarged, 7.5 cm. in length. The general condition of the calf was unchanged.

On the 29th day the calf died. It was not a very strong animal at the beginning of the experiment; it was thin and did not thrive; after the 23rd day it began to get thinner and weaker, and on the morning of the 29th day was found on the ground in a dying condition and unable to rise; the respirations on the previous day were not obviously increased.

Temperature.



Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

	Kilogrammes.
August 30, 1905	29.48
September 28, 1905	23.12

Total loss of weight.—6.36 kilogrammes.

Average rate of loss per week.—1.58 kilogramme.

POST-MORTEM EXAMINATION.

Carcass.—Emaciated.

Seat of Inoculation.—In the subcutaneous tissues on the left side of the neck there was a flattened mass of dense yellow caseo-necrotic tissue, 10 by 5 by 1.5 c.m.; the mass was adherent to the skin and muscles, both of which were infiltrated to a slight extent.

Left Prescapular Gland.—The left prescapular gland measured 6.5 by 4 by 2.5 c.m. On section the greater part of the substance was composed of dense yellow caseated tissue; whilst the rest, chiefly around the hilum, was closely beset with small caseous tubercles.

Prepectoral Glands, Right Prescapular Gland.—The prepectoral glands on both sides and the right prescapular gland showed discrete irregular caseous tubercles in the cortices.

Cervical Glands.—On the left side a small gland near the inferior extremity of the tumour was caseous throughout; two others in the middle of the neck showed part of their cortex caseating. The superior cervical gland, near the mastoid, showed a reddish grey caseating patch and numerous discrete caseous tubercles.

The glands on the right side showed small caseous tubercles or caseous foci.

Abdomen.

Omentum.—On the inferior surface of the omentum were numerous grey tubercles, many loosely attached and deeply hæmorrhagic.

Peritoneum.—Normal.

Spleen.—The spleen was slightly enlarged, and weighed 226.5 grammes. On section the pulp was packed with opaque miliary tubercles, which gave the cut surface a coarsely granular appearance.

Liver.—The liver was mottled on the surface with purplish patches. The substance contained moderately numerous tubercles, ranging in size from a mere point up to about 1 millimetre in diameter; the larger ones were opaque in the centre.

Gall Bladder.—The gall bladder showed three opaque yellow foci under the mucous membrane.

Portal Glands.—The portal glands were slightly enlarged, and showed the cortex firm, grey, and in a state of early caseation; the glands were soft and oedematous in the centre.

Kidneys.—The kidneys contained sparsely scattered tubercles, the largest a little over a millimetre in diameter; they were slightly opaque in the centre.

Suprarenals.—The right suprarenal body contained an opaque tubercle the size of a pin's head.

Thorax.

Heart, Parietal Pleura.—Normal.

Diaphragm.—On the pleural surface of the diaphragm there was one pinhead-sized caseous tubercle.

Lungs.—The lungs showed only a moderate number of small tubercles, the largest about a millimetre in diameter. The tubercles had congested grey margins and opaque caseous centres. There were no large areas of consolidation, but in the left lobes a few lobules were dark and collapsed (not recent). In the latter lobes many of the tubercles or small groups of tubercles were surrounded by little angular patches of red hepatisation.

Bronchial and Mediastinal Glands.—The bronchial and mediastinal glands were moderately enlarged; they showed in the cortices grey or reddish grey translucent tissue, containing a fine yellow caseous network.

The ventral mediastinal glands were closely beset with yellow caseous tubercles, irregular in outline.

Larynx, Trachea.—Normal.

Alimentary Tract.

Tonsils.—The tonsils contained each a few caseous tubercles.

Tongue, Pharynx.—Normal.

Small Intestine.—All the Peyer's patches contained minute yellow caseous tubercles; they were very numerous in the long Peyer's patch, and not so numerous in the others. In the mucous membrane a few sparsely scattered tubercles were seen; in the middle part the mucous membrane showed three or four hæmorrhagic erosions.

Large Intestine.—Normal.

Mesenteric Glands.—The mesenteric glands were slightly enlarged; the cortex of each was composed throughout of grey translucent tissue containing a fine caseous network. In the medullary parts of the glands were discrete pinhead-sized caseous tubercles.

Ileo-Colic Glands.—The ileo-colic glands were similarly, but rather less severely, affected.

Colic Glands, Gastric Glands.—These glands contained numerous caseous foci.

Various Lymphatic Glands.

Precurral, Popliteal, Pubic, Gluteal, Axillary.—All contained numerous small irregular caseous tubercles.

Ischiatic.—These glands showed a few minute caseous foci.

Submaxillary, Retropharyngeal.—These glands were very closely beset with minute caseous tubercles.

Coeliac.—The coeliac glands were slightly enlarged, and showed early caseous foci in the cortex.

A few hæmolymph glands contained small caseous tubercles.

Testes, Eyes.—Normal.

Microscopical Examination.

Tubercle from Suprarenal Body.—No tubercle bacilli seen.

VIRUS P. VI.
(April 28, 1905.)
INGUINAL GLAND.

CULTURE INOCULATIONS, SEPTEMBER 1, 1905.

The strain was derived from the original material through G.P. 1515, and had been in cultivation a total period of 126 days.
The culture used was the 6th generation, 20 days old.

CALF 326.

Subcutaneous.

Dose : 50 mg.

Killed when very ill :

Sept. 30, 1905. 29 days.

P.M.—General Tuberculosis, severe.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
403	Intrav.	0·1 mg.	D. 20 days	G. T.
401	Intrap.	1·0 mg.	D. 15 „	G. T.
404	Intrap.	1·0 mg.	D. 20 „	G. T.
405	Intrap.	0·1 mg.	D. 33 „	G. T.
407	Intrap.	0·01 mg.	D. 36 „	G. T.
402	Subcut.	1·0 mg.	D. 71 „	G. T.
406	Subcut.	0·1 mg.	D. 88 „	G. T.

CALF 326. Virus P. VI.

Subcutaneous inoculation of culture derived from the original material of Virus P. VI through G.P. 1515.
Dose—50 milligrammes.

Date—September 1, 1905.

Weight at Inoculation—41·27 kilogrammes. [Age about 6½ weeks.]

Killed when very ill—September 30, 1905. [29 days after inoculation.]

Clinical Notes.

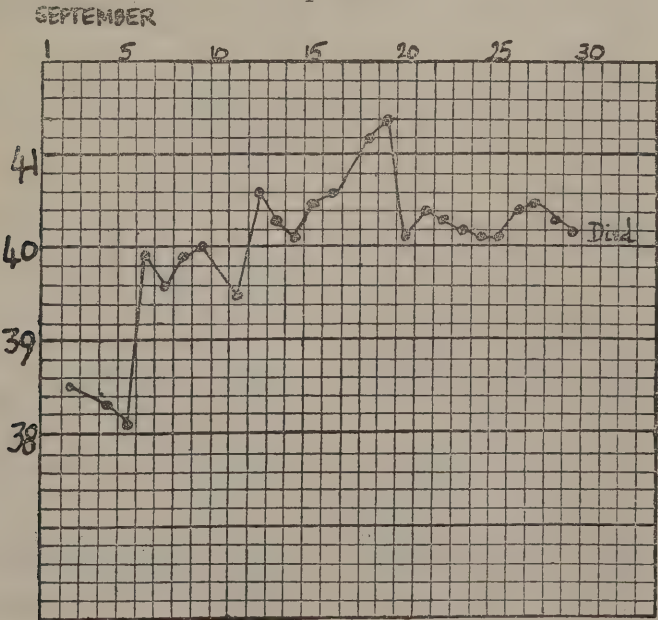
Five days after inoculation on the left side of the neck there was a local tumour measuring 7 by 5 cm. by about 2 cm. in thickness ; the prescapular gland was enlarged, 7 cm. in length.

On the 12th day the tumour measured 14 by 10 by about 4 cm. ; it was prominent and firm except in the centre where a sense of deep fluctuation was obtained. The prescapular gland was considerably enlarged, 10 cm. in length.

• On the 21st day the tumour measured 16·5 by 12·7 cm., and the tissues around the inferior extremity were oedematous. The calf was unwell ; there was some loss of flesh, its coat was staring, and there was slight increase in respiration.

On the 29th day the calf was killed. During the previous week it had continued to lose flesh and to become weaker ; the respirations were also obviously increased in frequency but were not very rapid ; the animal would probably have lived two or three days longer.

Temperature.



Tuberculin Test.—The calf was not tested subsequent to inoculation.

<i>Weights.</i>		Kilogrammes.
September 5, 1905	... ..	41.27
September 19, 1905	... ..	43.53
September 30, 1905	... ..	39.45

Total loss of weight during experiment.—1.82 kilogramme.

POST-MORTEM EXAMINATION.

Carcass.—In poor condition.

Local lesion.—At the seat of inoculation on the left side of the neck there was a tumour, weighing with the skin and muscles to which it was attached 793 grammes, and measuring 14 by 11.5 by 6 cm. On section it showed between the skin and muscles a mass of firm pinkish yellow caseo-necrotic tissue, containing in the upper part a cavity, 6.5 by 4 by 2.5 cm., filled with clear reddish serous fluid. The muscles internal to the mass were fibroid, and infiltrated for a considerable depth with yellow caseous nodules; the nodules were for the most part arranged in lines which ran parallel to the muscle fibres.

The skin was firmly adherent, and closely beset with yellow tubercles; opposite the cavity it was deeply congested.

There was a moderate amount of oedema fluid in the tissues around the local tumour, particularly near the inferior part.

Left Prescapular Gland.—The left prescapular gland weighed 170 grammes, and measured 10 by 5 by 4 cm. On section it was composed throughout of dense tissue, chiefly uniform and pinkish yellow in colour, but in parts greyish and translucent, and mottled with a close yellow network.

At the inferior extremity of the prescapular gland there was a gland the size of a small marble, composed of translucent tissue, moderately well advanced in caseation.

Prepectoral Glands.—The rounded prepectoral gland on the left side, the size of a Barcelona nut, was tense and closely beset with minute whitish foci.

The kidney-shaped prepectoral gland was much enlarged and firmer than normal, but showed only one or two caseous foci; a smaller gland more posterior was similarly affected.

Cervical Glands.—Along the left side of the trachea there was a chain of half a dozen glands, the largest the size of a pigeon's egg; several resembled the left prescapular, the others were slightly less advanced in caseation.

The left upper cervical gland, the size of a walnut, was composed throughout of dense yellow caseous tissue; a large gland near the latter showed a caseating mass in one part of the cortex, and in the rest scattered greyish white tubercles.

Just within the entrance to the thorax, on the left side, there was a large gland, composed of dense translucent tissue, containing a close yellow caseous network.

In the middle of the neck, on the right side, there was a gland the size of a small bean, composed of grey translucent tissue with a yellow network. All other glands on this side were slightly enlarged, and showed irregular caseous foci.

Thorax.

Heart.—On the endocardium of the right ventricle one grey point was seen; otherwise the heart was normal.

Pleura.—On the pleural surface of the diaphragm there were about eight nodules, the largest the size of a wheat grain; one was loosely attached and haemorrhagic. There were a few similar nodules on the fringes along the margins of the ribs; also here and there clusters of minute grey granules.

Lungs.—The ventral part of the left cephalic lobe and the ventral portions of the right cephalic and middle lobes were, with the exception of a few lobules along the margins, dark red and quite airless; in the anterior parts of the caudal lobes there were a few isolated solid lobules. The lung tissue was moderately closely beset with grey tubercles, slightly opaque in the centre, the largest about one millimetre in diameter. The tubercles appeared to be rather more

numerous in the solid than in the crépitant portions. The bronchi in the collapsed areas were filled with muco-pus.

Bronchial and Mediastinal Glands.—The bronchial and mediastinal glands were moderately enlarged. The cortices were composed of firm grey tissue, containing an opaque yellow caseous network.

One infratracheal gland resembled the bronchial; another was enlarged and oedematous, but showed no caseous foci.

Trachea.—The mucous membrane of the anterior end of the trachea showed three or four slightly raised elongated greyish tubercles containing caseous points.

Abdomen.

Omentum.—On the inferior surface there were fairly numerous lenticular nodules, the largest the size of a wheat grain. All were yellow in the centre, and the majority were loosely attached, some being deeply haemorrhagic.

Parietal Peritoneum.—Normal.

Spleen.—The spleen weighed 283 grammes. The pulp was closely beset with yellow caseous tubercles, somewhat irregular in outline, and ranging up to about 2 millimetres in diameter.

Liver.—The liver contained very numerous tubercles, evenly distributed throughout the substance. The tubercles were grey, and ranged in size from a mere point up to about 1 millimetre in diameter, the larger ones showing opaque yellow centres; some of the tubercles on the surface, under the capsule, were flattened out to a greater diameter.

Gall Bladder.—Under the mucous membrane of the gall bladder there were three yellow pinhead-sized tubercles.

Portal Glands.—The portal glands were enlarged and very oedematous; they showed in the cortices grey translucent tissue, chiefly in the form of nodules, speckled with white caseous foci.

Kidneys.—The left kidney showed on the surface, as well as in the depth of the cortex, moderately numerous grey tubercles, the largest about 1 millimetre in diameter, the smallest just visible; the larger ones were definitely opaque in the centre.

The right kidney showed similar tubercles.

Suprarenal Bodies.—In the cortex of the left suprarenal three minute grey tubercles were seen.

In the right suprarenal two or three very minute grey points were seen.

Alimentary Tract.

Tongue.—On the right side of the tongue there was one minute grey tubercle.

Pharynx.—Normal.

Tonsils.—Each tonsil contained a few caseous tubercles.

Small Intestine.—The Peyer's patches contained sparsely scattered opaque whitish tubercles, smaller than a pin's head.

Large Intestine.—Normal.

Mesenteric Glands, Gastric Glands, Colic Glands.—These glands contained scattered discrete caseating miliary tubercles.

Testes.—Normal.

Eyes.—Normal.

Various Lymphatic Glands.

Precrural, Popliteal, Gluteal, Ischiatic, Pudic, Lumbar, Iliac.—These glands contained fairly numerous discrete tubercles, somewhat irregular in outline, ranging in size up to 1.5 and 2 millimetres; the tubercles were all caseous in the centre.

Right Prescapular, Right Prepectoral, Axillary (Right and Left).—They contained similar discrete caseating tubercles.

Parotid, Submaxillary, Pharyngeal, Renal.—In the parotid, submaxillary, and pharyngeal glands, and in the renal gland, the tubercles were rather more numerous.

Coeliac.—The coeliac glands were a little enlarged, and showed in the cortices early caseous foci in a grey translucent matrix.

Several haemolymph glands contained small caseous tubercles.

VIRUS P. VIII.

(May 11, 1905.)

SUBMAXILLARY GLAND.

CULTURE INOCULATIONS, SEPTEMBER 5, 1905.

The strain was derived from the original material, and had been in cultivation a total period of 117 days.

The culture used was the 5th generation, 20 days old.

CALF 328.

Subcutaneous.

Dose : 50 mg.

Died October 3, 1905.

28 days.

P.M.—General Tuberculosis, severe.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
427	Intrav.	0.1 mg.	D. 18 days.	G. T.
424	Intrap.	1.0 mg.	D. 18 "	G. T.
426	Intrap.	0.1 mg.	D. 27 "	G. T.
429	Intrap.	0.01 mg.	D. 32 "	G. T.
425	Subcut.	1.0 mg.	D. 62 "	G. T.
428	Subcut.	0.1 mg.	D. 87 "	G. T.

CALF 328. Virus P. VIII.

Subcutaneous inoculation of culture derived from the original material of Virus P. VIII.

Dose—50 milligrammes.

Date—September 5, 1905.

Weight at Inoculation—34.0 kilogrammes. [Age about 6 weeks.]

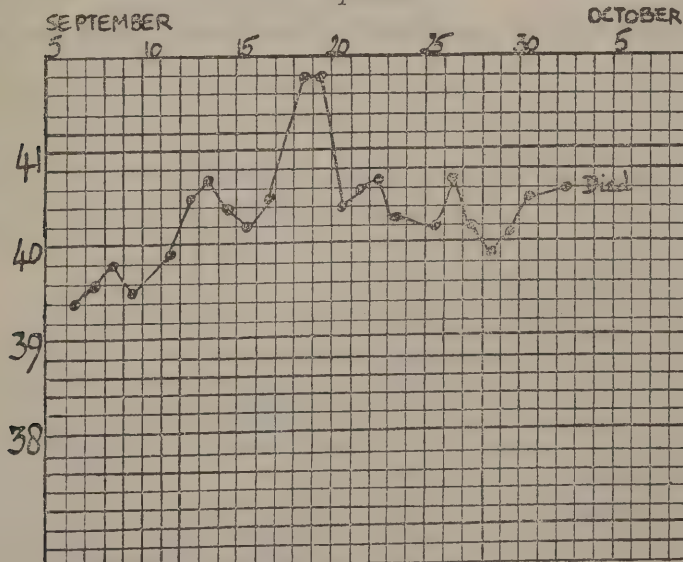
Died—October 3, 1905. [28 days after inoculation.]

Clinical Notes.

Eight days after inoculation on the left side of the neck, there was a local tumour measuring 9 by 5.5 cm.; the adjacent prescapular gland was slightly enlarged, 6.5 cm. in length.

On the 17th day the tumour measured 14 by 9 cm.,

it was pear shaped in outline, and about 2.5 cm. thick. The prescapular gland was very large and measured 12.5 cm. in length. Up to this time the general condition of the animal had been good; it now began to lose weight, and became thin and ill. The progress of the disease was very rapid and the animal died on the 28th day after inoculation.

Temperature.

Tuberculin Test.

The calf was not tested subsequent to inoculation.

Weights.

			Kilogrammes.
September 5, 1905	...	...	34.0
September 19, 1905	...	...	36.28
September 26, 1905	...	...	35.37
October 3, 1905	...	...	31.29

Total loss of weight.—2.71 kilogrammes.

POST-MORTEM EXAMINATION.

Local Lesion.—At the seat of inoculation in the subcutaneous tissues on the left side of the neck there was a flattened tumour, weighing 340 grammes, and measuring 14 by 9 by 4 cm. It was composed of a dense yellowish network of caseous tissue, softening in the centre, where there was a small cavity containing turbid fluid.

Left Prescapular Gland.—The left prescapular gland weighed 170 grammes, and measured 10 by 6.5 by 4.5 cm., and was adherent to the subjacent muscle. It was firm, and the cortex was infiltrated with a yellow caseous network, the hilum containing discrete tubercles.

Left Prepectoral Glands.—The left prepectoral (reniform) gland measured 2.5 by 2 cm. It was oedematous, and contained in the cortex four yellowish foci about a pinhead in size. The round prepectoral gland was firm, and infiltrated with irregular caseous foci.

Right Prescapular Gland.—The right prescapular gland contained fairly numerous opaque yellow tubercles, about 1 millimetre in diameter.

Cervical Glands.—The cervical glands on the left side in the mid cervical region contained numerous very minute opaque foci. A lower cervical gland, three centimetres long, contained at one extremity a few isolated tubercles, and at the other numerous minute caseous foci. On the right side the cervical glands contained fairly numerous minute caseous foci in the cortices.

Thorax.

Heart.—In the muscle of the heart there was one grey tubercle; the valves and endocardium were normal.

Lungs.—The left lung was closely filled with grey tubercles, opaque in the centre, varying in size up to 1.5 millimetre, and becoming confluent in patches. The anterior lobe was solid and sank in water.

The substance of the right lung was similarly filled with tubercles, and the greater part of its anterior and middle lobes, and the apex of the posterior lobe were solid and airless.

Bronchial Glands.—The right bronchial gland was firm and infiltrated with yellow caseous foci.

The left bronchial gland contained numerous minute foci in the cortex.

Mediastinal Glands.—The posterior mediastinal

glands were infiltrated throughout the cortex with yellow caseous foci. Four other glands contained foci numerous but still discrete.

Thyroid.—On the posterior part of the thyroid cartilage internally were nine flattened translucent tubercles, caseous in the centre, and up to 2.5 millimetres in diameter.

Trachea.—There were four similar tubercles down the trachea.

Abdomen.

Omentum.—On the omentum were sparsely scattered flattened grey tubercles, opaque in the centre, about 1.5 millimetre in diameter.

Spleen.—The spleen weighed 283 grammes, and was closely packed with greyish opaque miliary tubercles.

Liver.—In the liver were numerous grey tubercles, caseous in the centre, varying in size from a pinpoint up to 1.5 millimetre.

Portal Glands.—The portal glands contained numerous minute opaque foci in the cortices, giving them a yellowish granular appearance.

Gall Bladder.—In the mucous membrane of the gall bladder were ten opaque tubercles, the largest the size of a pinhead.

Kidneys.—The kidneys contained sparsely scattered grey tubercles with caseous centres, from a point up to 1 millimetre in diameter.

Alimentary Tract.

Pharynx, Tongue.—On each side of the pharynx, on the folds at the root of the tongue, were four small opaque tubercles.

Tonsils.—The tonsils were normal.

Intestines.—Sparsely scattered over the mucous membrane of the small intestine were minute yellowish tubercles. There were a few in the Peyer's patches.

Large intestine normal.

Mesenteric Glands.—In all the mesenteric glands there was a moderate number of opaque slightly yellow tubercles, varying in size up to a small shot.

Ileo-Colic Glands.—In the ileo-colic glands a few pinhead-sized opaque tubercles were visible, and the substance felt firm.

Lymphatic Glands.

Gastric, Coeliac, Precural, Popliteal, and Gluteal.—They contained numerous minute opaque yellow tubercles.

Axillary, Iliac, Sacro-Iliac, Lumbar, and Retro-pharyngeal.—All contained rather larger caseous tubercles.

Parotid.—In the parotid lymphatic glands there were several yellow tubercles, the largest almost equal to a wheat grain in size.

The haemolymph glands contained caseous foci.

VIRUS P. IX.

(May 18, 1905.)

SUBMAXILLARY GLAND.

CULTURE INOCULATIONS, SEPTEMBER 20, 1905.

The strain was derived from the original material, and had been in cultivation
a total period of 125 days.

The culture used was the 7th generation, 20 days old.

CALF 334.

Subcutaneous.

Dose : 50 mg.

Died : November 4, 1905.

45 days.

P.M.—General Tuberculosis, severe.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
469	Intrav.	0·1 mg.	D. 16 days	G. T.
466	Intrap.	1·0 mg.	D. 20 „	G. T.
468	Intrap.	0·1 mg.	D. 30 „	G. T.
465	Subcut.	10·0 mg.	D. 28 „	G. T.
467	Subcut.	1·0 mg.	D. 51 „	G. T.
470	Subcut.	0·1 mg.	D. 80 „	G. T.

CALF 334. Virus P. IX.

Subcutaneous inoculation of culture derived from the original material of Virus P. IX.

Dose—50 milligrammes.

Date—September 20, 1905.

Weight at Inoculation—41·72 kilogrammes. [Age about 9 weeks.]

Died—November 4, 1905. [45 days after inoculation.]

Clinical Notes.

Ten days after inoculation on the left side of the neck an elongated local tumour had developed, extending into the dewlap; it measured superficially 15 by 7·5 cm. The adjacent prescapular gland was enlarged, 7·5 cm. in length; the prepectoral gland was the size of a large marble.

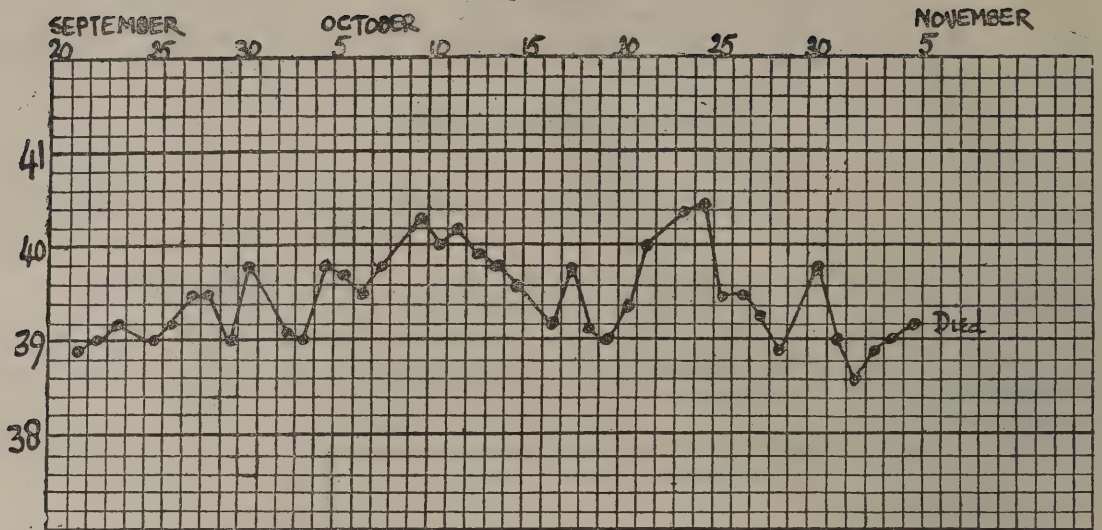
On the 20th day the tumour was very large, extending from the middle of the neck to below the level of the trachea; it measured 18 by 12·5 cm. and projected considerably. There was a large amount of

oedema in the dewlap and around the inferior part of the tumour.

The prescapular gland was 12·5 cm. long, and the prepectoral gland was very large; the animal was beginning to lose flesh and its coat was rough, its respiration was not much increased.

On the fortysecond day the tumour measured about 23 by 12·5 cm. and was very prominent and thick, extending into the dewlap and surrounded at the lower part by much oedema. The animal was much emaciated, the appetite poor, and the respiration increased though not to a marked degree. Weakness and emaciation increased, and the calf died three days later.

Temperature



Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

		Kilogrammes.
September 20, 1905...	...	41.72
September 26, 1905	...	43.08
October 5, 1905	...	41.72
October 10, 1905	...	43.08
November 4, 1905	...	40.36

Total loss of weight during experiment.—1.36 kilogramme.

POST-MORTEM EXAMINATION.

Carcass.—Emaciated.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a very large tumour measuring 20.5 cm. vertically, 12.5 cm. from side to side and 5.5 cm. in greatest thickness; it extended into the loose tissues of the neck and under the trachea slightly to the opposite side; on removal it weighed with the infiltrated skin and muscles 907 grammes; on section it showed between the skin and muscles a mass of dense yellow caseo-necrotic tissue, spongy and juicy in the centre, 3 cm. in greatest thickness; the skin was thickened thoroughly adherent to the necrotic mass and extensively infiltrated with caseous tubercles; the epidermis was cracked and could be peeled off from the greater part of the tumour exposing a red granular surface; the muscles for a depth of 2.5 cm. were closely studded with yellow caseous nodules and showed a great increase in interstitial connective tissue. Between the local tumour and the nearest glands there were several thickened caseous lymphatic vessels.

The tissues around the lower part of the tumour were oedematous.

Left Prescapular Gland.—The left prescapular gland weighed 170 grammes, and measured 9.5 by 4.5 by 5.5 cm.; on section it was composed throughout of dense pinkish yellow caseated tissue very slightly gritty from calcification (the muscles around the gland were tightly adherent to the capsule but not infiltrated).

Left Prepectoral Glands.—The rounded prepectoral gland was a little over 2.5 cm. in diameter and resembled the prescapular. The reniform gland, 3.5 cm. in length, was oedematous and showed part of the cortex composed of reddish grey tissue beset with early caseous foci.

Cervical Glands.—On the left side the superior cervical gland showed part of the cortex composed of greyish red tissue beset with caseous foci; a mid-cervical gland, the size of a thrush's egg, was indurated and caseating throughout (not so advanced as the prescapular); two smaller glands nearer the thorax were indurated and showed streaks and foci of caseation; a gland, the size of a pigeon's egg, close to the entrance to the thorax was dense yellow

and caseous throughout; the corresponding gland on the opposite side was enlarged and showed a small patch of the cortex yellow and caseous, the rest translucent and closely beset with yellow caseous foci: other cervical glands on the right side contained each a few caseous nodules.

Abdomen.

Omentum and Peritoneum.—The omentum showed numerous discrete flattened nodules ranging in size from a millet seed to a split pea; they were firm, yellowish in the centre and greyish red around the margins. On the parietal peritoneum there was one loosely attached lenticular nodule about the size of a split pea.

Spleen.—The spleen was very firm and much enlarged (weight 538 grammes). On the surface there were two flattened caseating nodules, the largest 5 mm. in diameter: on section the pulp was packed with irregular yellow caseous nodules with reddish margins ranging up to about 5 mm. in diameter.

Liver.—The liver was enlarged and pale; on the surface under the capsule numerous nodules ranging in size from 1 to about 5 mm. in diameter were seen; the larger ones were slightly raised above the surface and on section were thin and compressed; in the depth of the liver there was numerous evenly distributed yellow caseous tubercles, the largest about 2 mm. in diameter.

Gall Bladder.—The gall bladder showed one sub-mucous caseous tubercle.

Portal Glands.—The portal glands were enlarged and showed in the cortices irregular coalescing nodules with caseous centres and grey margins.

Kidneys.—The left kidney showed in the cortex moderately numerous tubercles ranging in size from a pin's head to a wheat grain; they were yellow and caseous in the centre and had grey translucent margins; scattered about was a number of minute points just visible to the eye; most of these were grey, a few were yellowish.

The right kidney contained similar tubercles; they were however not so numerous and generally smaller.

Suprarenal Bodies.—The suprarenal bodies were pale; no tubercles seen.

Thorax.

Heart.—Under the pericardium covering the right auricle there was a caseous tubercle a little smaller than a wheat grain; otherwise the heart was normal.

Pleura.—Along the margins of the ribs chiefly in the dorsal regions were lines of vascular vegetations containing flattened caseating tubercles up to 1.5 mm. in diameter. On the pleural surface of the diaphragm there were numerous patches of slightly raised reddish vegetations containing small yellowish white tubercles; there were similar patches on the caval fold of pleura and on the pleura covering the pericardium.

Lungs.—The lungs were heavy; the cephalic and right middle lobes were dark-red and almost completely solid; on the surfaces of the right cephalic and middle lobes were some small patches of yellow slightly adherent lymph; the antero-ventral parts of the caudal lobes were dark red and consolidated, and in the rest of these lobes there were irregular patches of consolidation. The lung substance was moderately closely beset with yellow caseating tubercles ranging in size from a pin's head to a wheat grain; they appeared to be most numerous in the solid parts of the lung; the subpleural tubercles in the anterior lobes were considerably flattened out. The cut surfaces of the caudal lobes exuded frothy oedema fluid.

Thoracic Lymphatic Glands.—The caudal mediastinal gland was much enlarged and showed the cortex composed of firm translucent grey tissue mottled with irregular yellow patches of caseation in places forming a network; the medulla was deeply congested and oedematous. The other dorsal mediastinal glands and the bronchial glands were similarly affected but a little more advanced in caseation.

The ventral mediastinal and the vertebral glands and a gland in the caval fold of pleura contained discrete yellow caseous nodules.

Trachea.—The trachea was filled with froth and showed on the mucous surface three slightly raised congested tubercles.

Alimentary Tract.

Tongue, pharynx, and larynx.—Normal.

Tonsils.—The tonsils showed each one or two small caseous nodules.

Small Intestines.—In the long Peyer's patch there was a moderate number of softened caseous tubercles, the largest about 1.5 mm. in diameter; in the rest of the intestine they were sparsely scattered.

Large Intestine.—Normal.

The Gastric, Mesenteric and Colic Glands resembled the precrrural.

Ileo-colic Glands.—The ileo-colic glands were enlarged, and showed the cortices composed of firm greyish red tissue beset with irregular caseous foci.

Various Lymphatic Glands.—The precrrural, popliteal, gluteal, pudic, parotid, submaxillary, axillary, right prescapular and right prepectoral glands contained a moderate number of irregular yellow caseous nodules ranging up to 3.5 or 4 mm. in diameter.

The left axillary gland was deeply congested, oedematous, and much enlarged; the right prescapular was slightly enlarged and congested.

The lumbar and right renal glands were enlarged and closely beset with caseous nodules becoming confluent.

The coeliac glands were enlarged and composed throughout of very dense translucent tissue mottled with irregular yellow patches of caseation.

All the haemolymph glands contained caseous nodules.

Testes.—Normal.

VIRUS P. XI.

(June 1, 1905.)

SUBMAXILLARY GLAND.

CULTURE INOCULATIONS, SEPTEMBER 6, 1905.

The strain was derived from the original material, and had been in cultivation a total period of 97 days.

The culture used was the 4th generation, 20 and 21 days old.

CALF 338.

Subcutaneous.

Dose : 46·5 mg.

Died : October 13, 1905.

37 days.

P.M.—General Tuberculosis, severe.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
438	Intrav.	0·1 mg.	D. 19 days	G. T.
436	Intrap.	1·0 mg.	D. 17 "	G. T.
439	Intrap.	0·1 mg.	D. 23 "	G. T.
440	Intrap.	0·1 mg.	D. 27 "	G. T.
442	Intrap.	0·01 mg.	D. 29 "	G. T.
437	Subcut.	1·0 mg.	D. 120 "	G. T.
441	Subcut.	0·1 mg.	D. 62 "	G. T.

CALF 338. Virus P. XI.

Subcutaneous inoculation of culture derived from the original material of Virus P. XI.

Dose—46·5 milligrammes.

Date—September 6, 1905.

Weight at Inoculation—31·75 kilogrammes. [Age about 6 weeks.]

Died—October 13, 1905. [37 days after inoculation.]

Clinical Notes.

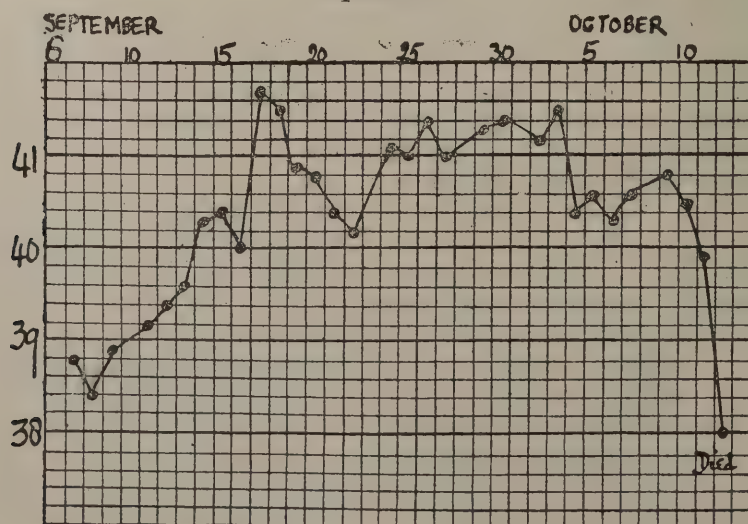
Seven days after inoculation on the left side of the neck there was a firm local tumour adherent to skin and slightly adherent to muscle, measuring 7·5 by 5 cm., and about 1·25 cm. thick. The adjacent prescapular gland was slightly enlarged, 6·5 cm. in length.

On the 24th day the tumour was elongated, measuring 15 by 7 cm. by about 2·5 cm. in thick-

ness; the prescapular gland was moderately enlarged, 9 cm. in length; the prepectoral gland was slightly enlarged. The general condition of the animal was not very good.

On the 34th day the animal's condition was poor, its coat was rough, and there was slight emaciation; respiration 48, somewhat jerky.

Three days later the calf died.

Temperature.

Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

			Kilogrammes.
September 6	...	...	31.75
September 12	...	...	33.55
September 19	...	...	34.91
September 26	...	...	32.65
October 13	...	...	26.30

Total loss of weight.—5.43 kilogrammes.

Rate of loss per week.—1.04 kilogramme.

POST-MORTEM EXAMINATION.

Carcass.—In poor condition.

Local Lesion.—The tumour at the seat of inoculation on the left side of the neck was lenticular in outline, measuring 12.5 by 7 cm. by a little over 2.5 cm. in greatest thickness, and weighing with skin and muscles 226 grammes. It was composed of the usual pinkish yellow caseo-necrotic tissue, showing in the centre a series of small spaces filled with yellow serous fluid.

The muscles were infiltrated for a short distance; the skin was thickened, and studded with yellow tubercles, particularly over the centre of the tumour.

Left Prescapular Gland.—The left prescapular gland weighed 141 grammes, and measured 9 by 6 by 4 cm. On section it consisted throughout of dense pinkish yellow caseated tissue.

Left Prepectoral Glands.—One, the size of a pigeon's egg, showed the cortex firm and in a state of early caseation; the medulla was distended with oedema fluid. Another gland was enlarged, oedematous, and contained discrete yellow tubercles.

Cervical Glands.—A small gland in the middle of the neck on the left side showed the greater part of the cortex in a state of early caseation; other cervical glands contained discrete caseous tubercles.

Thorax.

Heart.—Normal.

Parietal Pleura.—The parietal pleura showed a few flattened caseating nodules, and here and there a slight hypertrophy of the lymphatic fringes, at the base of some of which minute grey granules were seen.

Diaphragm.—On the pleural surface of the diaphragm there was one small flattened caseating nodule, and slight hypertrophy of the lymphatic fringes.

Lungs.—The lungs were moderately closely beset with yellow caseous tubercles, ranging in size from a small point to a little over 1 millimetre in diameter; they were somewhat irregular in outline, and showed a tendency to occur in small groups. The right cephalic lobe, with the exception of the thin dorsal border, and the ventral portion of the right middle lobe, were extensively hepatized, being firm, heavy, and dark red. In the ventral portion of the left cephalic lobe and the antero-ventral portions of the caudal lobes there were patches of consolidation, irregular in outline, and not sharply defined, pieces from which sank in water. On the dorsal surface of the right caudal lobe there was a large patch of collapse, which appeared to be of old standing. In other parts of the lung single tubercles and groups of tubercles were surrounded by angular red patches. One of these patches showed early tuberculous infiltration.

Mediastinal Glands.—The caudal mediastinal gland was moderately enlarged, and showed the cortex dense, yellowish, and far advanced in caseation, very little grey translucent tissue remaining; the medulla was congested and oedematous.

Other mediastinal and the bronchial glands were similarly affected. They weighed together 85 grammes.

The infratracheal, oesophageal, ventral and mediastinal glands, and the glands in the caval fold, contained discrete yellow caseous tubercles.

Trachea.—On the mucous membrane in the anterior part of the trachea there was one caseous tubercle.

Abdomen.

Omentum.—On the inferior surface of the omentum were scattered lenticular loosely attached nodules, ranging up to 2 millimetres in diameter; all had yellow centres, and some were congested.

Spleen.—The spleen was enlarged, weight 283 grammes. The pulp was closely packed with yellow caseous nodules with greyish red margins, the largest about 2 millimetres in diameter.

Liver.—The liver contained moderately numerous opaque caseous tubercles, ranging in size from 0.5 or less up to 1 millimetre in diameter; they were evenly distributed throughout the substance.

Gall Bladder.—The gall bladder showed one pin-head-sized submucous tubercle, and three or four small ulcers with caseous floor and congested margins.

Portal Glands.—The portal glands were enlarged. They showed in the cortices nodular masses of aggregated caseating tubercles.

Kidneys.—The left kidney showed on the surface fairly numerous tubercles with grey margins and yellow centres, the majority the size of a millet seed, some barely visible to the eye. On section many of the larger surface tubercles extended for some distance down into the cortex. A few tubercles were seen in the depth of the cortex.

In the right kidney were similar, but less numerous tubercles. These did not show the same tendency to extend downwards into the cortex.

Suprarenals.—The left suprarenal showed one minute grey tubercle. The right was normal.

Alimentary Tract.

Tongue.—The mucous membrane at the base of the tongue showed two small ulcers with yellow necrotic floors.

Tonsils.—Each tonsil contained a few caseous tubercles.

Small Intestine.—Almost all the Peyer's patches contained pin-head-sized caseous tubercles in small number; they were most numerous in the long Peyer's patch. Caseous tubercles were seen also here and there under the mucous membrane.

Large Intestine.—Normal.

Mesenteric Glands.—The mesenteric glands were not enlarged. They contained discrete caseous tubercles and caseating patches in the cortices.

Gastric Glands and Colic Glands.—These glands contained discrete tubercles.

Various Lymphatic Glands.

Coeliac Glands.—Two coeliac glands were enlarged, firm, and on section showed yellow caseous patches; other coeliac glands contained discrete nodules.

Renal Gland.—The renal gland was enlarged, and closely beset with yellow caseous tubercles, up to 2 millimetres in diameter.

Preaural, Pudic, Popliteal, Gluteal, Ischiatic, Axillary, Right Prescapular, Right Prepectoral, and Parotid.—These glands contained yellow caseous nodules, somewhat irregular in outline, ranging in size up to about 2 millimetres.

Iliac, Ilio-Sacral, Submaxillary and Pharyngeal.—There were similar, but rather more numerous nodules in these glands.

Testes and Eyes.—Normal.

VIRUS P. XII.

(June 26, 1905.)

SUBMAXILLARY GLAND.

CULTURE INOCULATIONS, DECEMBER 14, 1905.

The strain was derived from the original material, through G.P. 1636, and had been in cultivation a total period of 101 days.

The culture used was the 5th generation, 20 days old.

CALF 376.

Subcutaneous.

Dose : 50 mg.

Killed when dying :

Jan. 2, 1906. 19 days.

P.M.—General Tuberculosis, severe.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
597	Intrav.	0.1 mg.	D. 19 days	G. T.
598	Intrap.	1.0 mg.	D. 16 "	G. T.
600	Intrap.	0.1 mg.	D. 18 "	G. T.
602	Intrap.	0.01 mg.	D. 75 "	G. T.
599	Subcut.	1.0 mg.	D. 97 "	G. T.
603	Subcut.	0.1 mg.	D. 105 "	G. T.
601	Subcut.	0.01 mg.	D. 89 "	G. T.

CULTURE INOCULATIONS, JUNE 29, 1906.

The strain was derived from the original material, through G.P. 1636, and had been in cultivation a total period of 298 days.

The culture used was the 9th generation, 21 days old.

CALF 444.

Subcutaneous.

Dose : 50 mg.

Killed when dying :

Aug. 16, 1906. 48 days.

P.M.—General Tuberculosis, severe.

CALF 450.

Subcutaneous.

Dose : 50 mg.

Died : Aug. 9, 1906.

41 days.

P.M.—General Tuberculosis, severe.

CALF 376. Virus P. XII.

Subcutaneous inoculation of culture derived from the original material of Virus P. XII through G.P. 1636.

Dose—50 milligrammes.

Date—December 14, 1905.

Weight at Inoculation—39.46 kilogrammes. [Age about 6 weeks.]

Killed when dying—January 2, 1906. [19 days after inoculation.]

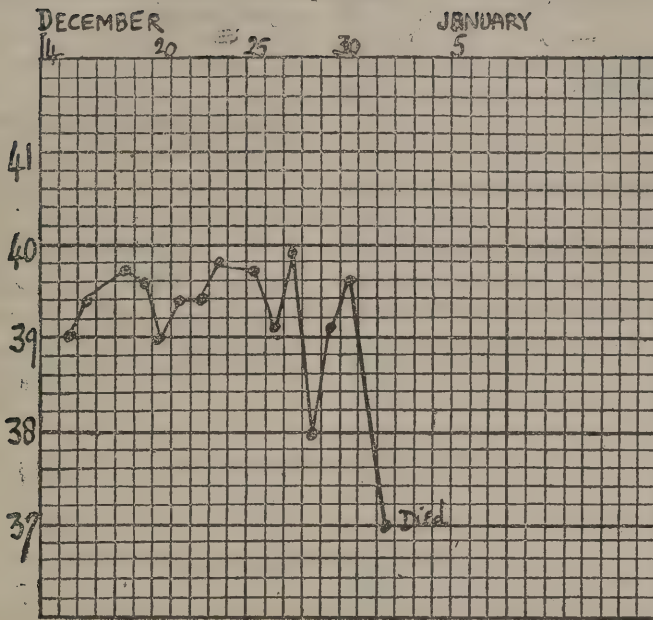
Clinical Notes.

Seven days after inoculation on the left side of the neck there was a local tumour measuring 10 by 5 cm.; the adjacent prescapular gland was enlarged, 6 cm. in

length; the prepectoral gland was the size of a walnut.

On the 18th day the calf became suddenly ill, refusing food. On the following morning it was found in a moribund condition, and was therefore killed.

Temperature.



Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

		Kilogrammes.
December 14, 1905	...	39.46
January 2, 1906	...	33.55

Total loss of weight.—5.91 kilogrammes.

POST-MORTEM EXAMINATION.

General Condition.—Moderate.

Local Lesion.—At the seat of inoculation there was a tumour, which measured 9 by 5.5 cm. in superficial area. On section it consisted of congested yellow necrotic tissue, broken down in the centre to form thin watery fluid, turbid with caseous flakes. At this part the necrotic tissue infiltrated the muscles, and was about an inch in thickness. The greater part of the tumour, however, was thin, and situated wholly in the subcutaneous tissue.

Two thickened caseous lymphatic vessels extended from the local tumour towards the prescapular gland.

Left Prescapular Gland.—The left prescapular gland weighed 56 grammes, and measured 8 by 4.5 by 2.5 cm. On section the cortex was composed practically throughout of dense pinkish yellow caseo-necrotic tissue.

Right Prescapular Gland.—The right prescapular gland appeared normal.

Prepectoral Glands.—The rounded prepectoral gland measured nearly 2.5 cm. in diameter, and was composed throughout of dense pinkish yellow caseo-necrotic tissue; the reniform gland was enlarged, and showed part of the cortex firm, and in a state of early caseation.

The prepectoral glands on the right side appeared normal.

Axillary Glands.—The axillary glands appeared normal.

Cervical Glands.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs showed in various parts firm red patches of collapse with a lobular outline; they were largest in the right cephalic and middle lobes. The lung substance contained numerous grey translucent tubercles, mostly about 0.5 millimetre in diameter; the tubercles appeared to be most numerous in the anterior lobes.

Trachea.—Normal.

Thoracic Glands.—The caudal mediastinal gland was slightly enlarged and firmer than normal. On

section the cortex showed in some places a fine yellow network, in others irregular caseous foci, singly or in small groups. Other mediastinal and the bronchial glands were in a similar condition, but a little more extensively caseated.

Heart.—Muscle and valves normal.

Abdomen.

Omentum.—The omentum showed on the under surface a few minute congested tubercles. In the omental sac there was some yellowish turbid fluid together with flakes of lymph. Between the omentum, along its attachment, and the stomach, there was a band of yellow fibrinopurulent exudation, which contained clear serous fluid in the centre.

Stomach.—Near the pylorus, on the ventral surface of the stomach, there was an oval aperture, covered by omentum, which adhered to the margins. On the mucous surface the opening was seen to be situated in the centre of an ulcer, one inch in greatest diameter. The ulcer appeared to be of old standing, the margins being raised, thickened, and somewhat puckered; the base was thin, and showed in the centre the opening described above. Near the large ulcer there were two smaller ulcers with thickened margins.

Intestines.—Normal.

Mesenteric Glands.—There were a few doubtful tubercles in the mesenteric glands.

Spleen.—The spleen weighed 170 grammes. On the convex surface there was a thin layer of fibrinous lymph. On section the pulp was dark red, moderately firm, and showed no tubercles.

Liver.—The liver was firm and dark red, and showed throughout the substance moderately numerous opaque minute tubercles.

Gall Bladder.—Normal.

Portal Glands.—The portal glands were slightly enlarged, and beset in the cortices with irregular caseous foci.

Kidneys.—Each kidney showed in the cortex numerous grey ill-defined tubercles, the largest about 1 millimetre or less in diameter.

Suprarenals.—The right suprarenal body contained several minute pearly grey tubercles. The left appeared normal.

Lumbar Glands.—The lumbar glands contained a moderate number of irregular caseous foci.

Coeliac Glands.—One coeliac gland showed part of the cortex firm and grey, with early caseous foci.

Iliac Glands.—Each iliac gland showed one or two greyish white tubercles.

Genito-Urinary System.

Testes.—Normal.

Bladder.—The bladder was greatly distended; its mucous membrane was normal.

Special Glands.

Right Preaural.—Contained two caseous foci.

Left Preaural.—Normal.

Pudic.—One pudic gland contained a caseous focus; the other was normal.

Gluteal and Left Popliteal.—Each contained a few caseous foci.

Ischiatic, Submaxillary, and Parotid.—Normal.

Retropharyngeal.—Each contained one or two small grey tubercles.

Tongue, Tonsils, Pharynx, and Larynx.—Normal.

Eyes.—Normal.

Microscopical Examinations.

Pharyngeal Gland.—Numerous tubercle bacilli.

Gluteal Gland.—Numerous tubercle bacilli.

Mesenteric Gland.—No tubercle bacilli.

CALF 444. Virus P. XII.

Subcutaneous inoculation, on left side of neck, of culture derived from original material of Virus P. XII through G.P. 1636.

Dose—50 milligrammes.

Date—June 29, 1906.

Weight at Inoculation—37.19 kilogrammes. [Age about 7 weeks.]

Killed when dying—August 16, 1906. [48 days after inoculation.]

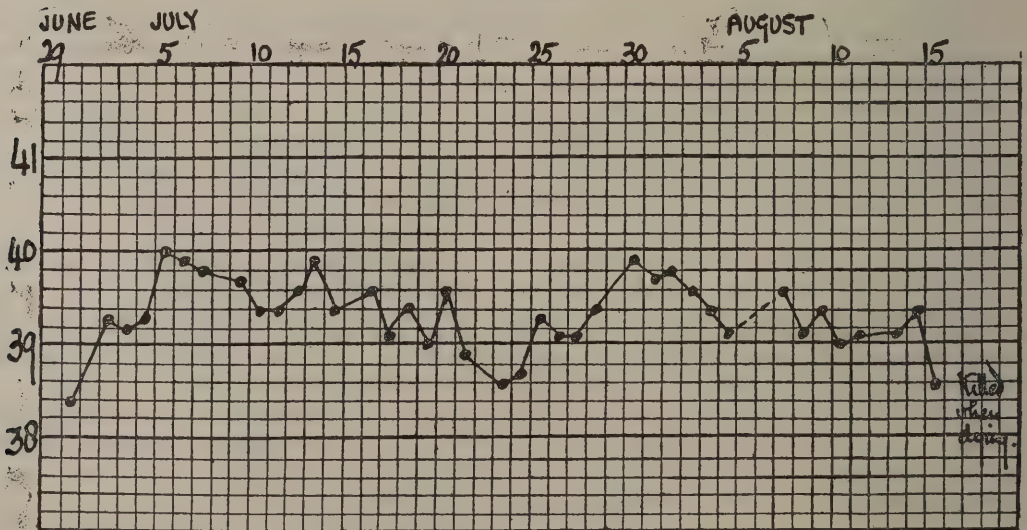
Clinical Notes.

Seven days after inoculation on the left side of the neck a flat subcutaneous thickening could be felt, 10 by 6.5 cm. in area; the adjacent prescapular gland was enlarged, measuring 7.5 cm. in length.

On the fourteenth day there was a firm prominent

infiltrating local tumour measuring 14 by 9 cm.; the prescapular gland measured 10 cm. in length.

The tumour continued to increase in size; on the fortieth day it measured 20 by 10 cm., and the gland was 12.7 cm. in length. The calf was unwell, the respiration was distinctly increased, and it was apparently losing flesh. The progress of the disease was subsequently very rapid, and the calf was killed when in a dying condition 8 days later.

Temperature.

Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

	Kilogrammes.
June 29, 1906	37.19
August 16, 1906	36.73
Total loss of weight during experiment.—460 grammes.	

POST-MORTEM EXAMINATION.

General Condition.—Thin.

Local Lesion.—At the seat of inoculation, on the

left side of the neck, there was a large firm tumour weighing, with skin and muscles to which it was attached, 538 grammes, and measuring 19 by 9 cm., by nearly 5 cm. in greatest thickness. On section it was lenticular in outline, and composed of pinkish yellow caseo-necrotic tissue a little spongy and juicy in the centre but containing no large cavity. The skin was thickened, universally adherent and beset with yellow caseous tubercles principally over the central part of the tumour. The muscles were infiltrated and caseous, to a greater extent and depth under the upper part of the tumour than under the lower.

Left Prescapular Gland.—The left prescapular gland weighed 170 grammes, and measured 9 by 5 by 5.5 cm.

and was composed throughout of dense pinkish yellow caseo-necrotic substance.

Right Prescapular Gland.—The right prescapular gland, not enlarged, contained several yellow caseous nodules, the largest 4 mm. in diameter.

Prepectoral Glands.—The rounded prepectoral gland on the left side, the size of a pea, was indurated and caseous around the cortex.

The kidney shaped gland on the same side was much enlarged and firmer than normal, and showed besides a number of small caseous foci several irregular caseous nodules up to a hemp seed.

The prepectoral glands on the right side contained several small caseous nodules.

Left Cervical Glands.—The glands in the middle of the neck were slightly enlarged, one was indurated and showed a few caseous foci in the cortex, the others contained discrete caseous nodules.

The superior cervical gland contained a number of nodules.

The mastoid gland was slightly enlarged and contained discrete caseous nodules up to a hemp seed, and one firm caseous nodule the size of a French bean.

Right Cervical Glands.—The cervical glands on the right side contained nodules similar to those in the peripheral lymphatic glands.

Axillary Glands.—The axillary glands contained nodules similar to those in the right prescapular.

Thorax.

Pleura.—The costal pleura was normal. On the pleura covering the diaphragm there was a loosely attached caseating nodule the size of a hemp seed.

Lungs.—The lungs were moderately closely beset with firm greyish yellow caseating nodules ranging in size from a pin's head to a small pea. The nodules were most numerous in the ventral portions of the lobes while in several places they were aggregated together and confluent. The nodules under the pleura were slightly raised above the surface and flattened. On section similar nodules were seen throughout the parenchyma; here and there in the depth were caseating masses occupying some part of a lobule; the ventral portions of the cephalic lobe and the antero-ventral portions of the caudal were diffusely consolidated but still air-containing; elsewhere in the lung single nodules and small groups of nodules were surrounded by angular red zones of consolidation.

Thoracic Glands.—Just within the entrance to the thorax there was a firm gland the size of a pheasant's egg which was dense yellow and caseous throughout.

The bronchial and mediastinal glands showed a moderate degree of enlargement. On section the cortices were firm and far advanced in caseation, only a small amount of grey translucent tissue remaining between the caseous areas.

Heart and Pericardium.—Normal.

Larynx and Trachea.—Normal.

Abdomen.

Omentum and Peritoneum.—On the ventral surface of the omentum there were three firm flattened lenticular nodules with yellow centres, the largest about 2 mm. in diameter. There was no hypertrophy of the fringes. The peritoneum was normal.

Spleen.—The spleen was small, weighing 113 grammes. It showed evenly distributed throughout the pulp a moderate number only of yellow firm tubercles, the largest a little larger than a millet seed.

Liver.—The liver at first sight appeared normal; on close inspection, however, a few very sparsely scattered opaque greyish white tubercles, the largest not more than 5 mm. in diameter were seen. On

section similar tubercles were sparsely scattered throughout the substance.

Gall Bladder.—Normal.

Portal Glands.—The portal glands were moderately enlarged and closely beset with coalescing caseous nodules arranged principally in groups.

Kidneys.—The left kidney showed on the surface four greyish-white translucent pinhead sized tubercles; none was seen in the depth.

On the surface of the right kidney there were two or three tubercles similar to those on the left, and also a few minute grey foci. In the depth of the cortex one pinhead-sized tubercle was seen.

Suprarenal Bodies.—The left suprarenal body contained one pinhead-sized tubercle. The right appeared normal.

Coeliac Glands.—Two coeliac glands were slightly enlarged, they were indurated and showed their cortices extensively caseated; other coeliac glands contained discrete caseous nodules up to a hemp seed in size.

The Iliac, Ilio-sacral, and Lumbar Glands were slightly enlarged and contained discrete caseating nodules.

Renal Gland.—The renal gland was distinctly enlarged, and closely beset with caseous nodules.

Alimentary Tract.

Pharynx.—Normal.

Tonsils.—One tonsil contained a pea sized caseous nodule, the other three or four, the largest the size of a hemp seed.

The Submaxillary, Pharyngeal, and Parotideal Glands contained numerous firm yellow caseous nodules, the largest 5 mm. in diameter.

Gastric Glands.—The gastric glands contained discrete caseous nodules.

Intestines.—All the Peyer's patches in the small intestine contained yellow caseous nodules up to about 2 mm. in diameter; they were most numerous in the long patch where several showed the mucous membrane over them ulcerated. There were a few nodules under the mucous membrane as well.

Large Intestine: Beneath the mucous membrane of the caecum and the early part of the colon there were numerous raised congested softened caseous nodules, the largest a little larger than a millet seed.

Mesenteric Glands.—The mesenteric glands were slightly enlarged and showed their cortices composed practically throughout of firm tissue in an advanced stage of caseation, but not so advanced as in the thoracic glands.

Colic Glands.—The colic glands contained discrete caseous nodules similar to those in the gastric glands.

Testes.—Normal.

Eyes.—Normal.

Various Peripheral Lymphatic Glands.

The Preaural and Pudic Glands contained numerous discrete firm yellow caseating nodules somewhat irregular in outline, the largest about the size of a hemp seed.

The Popliteal and Gluteal Glands resembled the preaural. One *Ischiatic gland* contained a caseating nodule.

Haemo-lymph Glands all over the body contained single caseous nodules up to a hemp seed in size.

CALF 450. Virus P. XII.

Subcutaneous inoculation of culture derived from the original material of Virus P. XII, through G.P. 1636.

Dose—50 milligrammes.

Date—June 29, 1906.

Weight at Inoculation—36.74 kilogrammes. [Age about 7 weeks.]

Died—August 9, 1906. [41 days after inoculation.]

Clinical Notes.

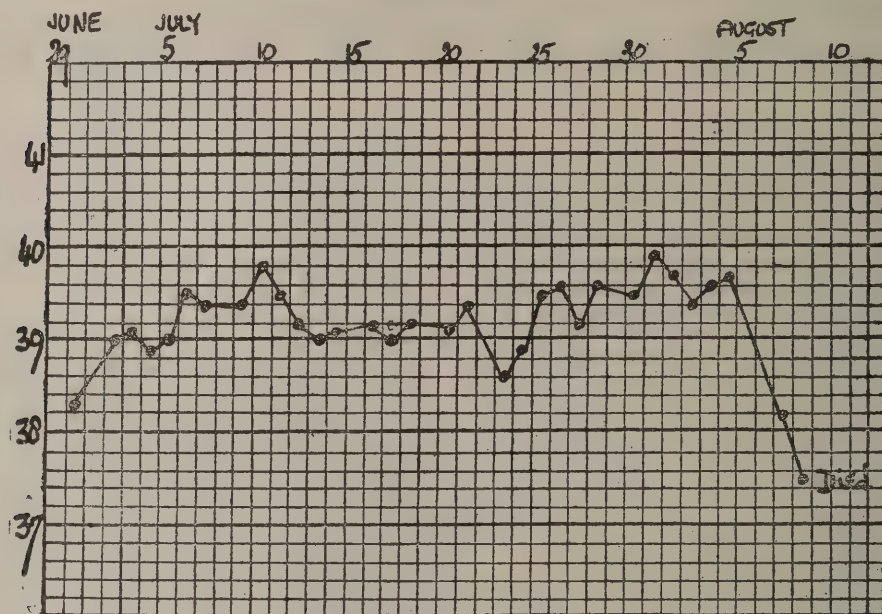
Seven days after inoculation on the left side of the neck there was a slightly raised firm local tumour measuring 7.5 by 5.5 cm. The prescapular gland was slightly enlarged, about 5 cm. in length.

On the fourteenth day the tumour measured 10 by 6 cm.; the adjacent muscles were slightly infiltrated, and there was some oedema of the dewlap. The

prescapular gland was considerably enlarged, 10 cm. in length.

The tumour continued to increase in size; on the twenty-eighth day it measured 12.5 by 7.5 cm. by about 1 cm. in thickness.

On the thirty-first day the respiration of the calf was increased in frequency; on the thirty-eighth day the animal was acutely ill; it was wasting and lay on the floor most of the day, the respiration was laboured but not very frequent. Three days later the calf was dead.

Temperature.

Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

			Kilogrammes.
June 29, 1906	...	...	36.74
August 9, 1906	...	...	34.46

Total loss of weight during experiment.—2.28 kilogrammes.

PGST-MORTEM EXAMINATION.

General Condition.—Thin.

Local Lesion.—At the seat of inoculation, on the left side of the neck, there was an oval tumour measuring 12.5 by 7.5 cm., by 3.2 cm. in greatest thickness, composed of yellow congested caseo-necrotic tissue infiltrating to a slight extent the muscles. The interior part of the tumour was spongy and juicy and softer than the peripheral part. The skin was everywhere adherent, and over the central part was infiltrated up to the surface and completely replaced by softening caseous substance; elsewhere the skin showed discrete yellow tubercles.

Left Prescapular Gland.—The left prescapular gland weighed 141 grammes, and measured 9 by 6.5 by 4 cm.; on section the cortex, except for a small patch at one extremity which contained discrete caseous tubercles, was composed of dense yellow somewhat congested caseous tissue.

Right Prescapular Gland.—The right prescapular gland contained discrete yellow caseous nodules.

Left Prepectoral Glands.—Two left prepectoral glands, the size of walnuts, were composed throughout of very dense yellow caseated tissue slightly congested and not perceptibly gritty.

Another gland, kidney shaped, 4 cm. in length, was oedematous and showed the cortex firmer than normal and beset with very minute early caseous foci.

Right Prepectoral Glands.—Normal.

Cervical Glands.—A left lower cervical gland, slightly enlarged, and firmer than normal, showed in the cortex numerous minute caseous points.

Other cervical glands on this side, and all those on the right, contained discrete yellow caseous nodules.

Axillary Glands.—The left axillary gland was slightly enlarged, and on section similar to the kidney-shaped left prepectoral gland.

The right axillary gland contained discrete yellow caseous nodules.

Thorax.

Pleura.—Along the margins of the ribs were small clusters of minute tubercles surrounded by reddish tissue forming incomplete lines. On the pleural surface of the diaphragm there were a few small congested villous tufts with no tubercles.

Lungs.—The lungs were heavy; the left lobes were extensively consolidated, very little air containing tissue remaining. The right lobes were more diffusely

consolidated and were of a terra-cotta colour mottled with irregular dark red patches of consolidation. The lung parenchyma was closely and evenly beset with yellow caseous tubercles varying in size from a mere point up to that of a millet seed.

Thoracic Glands.—The bronchial and mediastinal glands were moderately enlarged, weighing together about 112 grammes. On section the cortices were firm and composed of greyish red translucent tissue well advanced in caseation. The caseous areas formed irregular patches and in some places a coarse network.

Heart (muscle and valves).—Normal.

Larynx.—There was a miliary caseous tubercle in the mucous membrane of the larynx just above the left vocal cord.

Trachea.—The mucous membrane in the upper part of the trachea showed some scattered minute tubercles.

Abdomen.

Omentum and Peritoneum.—On the ventral surface of the omentum there were about half a dozen flattened congested nodules slightly opaque in the centre, the largest slightly larger than a millet seed.

The parietal peritoneum was normal.

Spleen.—The spleen was soft and slightly atrophied, it weighed a little over 141 grammes. On section the pulp contained a moderate number of discrete firm yellowish tubercles ranging in size from a pin's head to a millet seed.

Liver.—The liver was normal in size, and contained, evenly distributed, a moderate number only of greyish white tubercles ranging in size from a mere point to that of a pin's head.

Portal Glands.—The portal glands were slightly enlarged and closely beset in the cortices with caseating tubercles showing a tendency to form groups.

Kidneys.—The kidneys contained rather numerous grey tubercles, the largest 1 mm. in diameter, with minute opaque yellow centres. Some of these tubercles were elongated in a radial direction.

Suprarenal Bodies.—The left showed two greyish white tubercles in the cortex; the right contained one.

The Lumbar and Renal Glands were slightly enlarged and closely beset with caseous nodules tending to coalesce.

Coeliac Glands.—One coeliac gland, slightly enlarged, was composed of firm grey tissue mottled with irregular yellow caseous foci. Other coeliac glands contained more or less discrete yellow caseous nodules.

Alimentary Tract.

Tongue.—Normal.

Pharynx.—The pharynx was deeply congested, but contained no tubercles.

Tonsils.—Each tonsil contained a few caseous nodules, the largest the size of a hemp seed.

The Pharyngeal, Submaxillary and Parotid Glands were slightly enlarged, and contained numerous yellow caseous nodules varying in size up to that of a hemp seed.

Intestines.—The small intestine showed throughout its whole length numerous caseous tubercles, the largest the size of millet seed. These occurred chiefly in Peyer's patches and were most numerous in the long patch. There were a few caseous nodules in the caecum and the first part of the colon.

Gastric Glands.—The gastric glands were slightly enlarged and beset with caseous tubercles.

Mesenteric Glands.—The mesenteric glands contained numerous caseating nodules, which in some had coalesced.

Ileo-Colic Glands.—The ileo-colic glands were closely beset with tubercles.

Colic Glands.—The colic glands were slightly enlarged and beset with caseous tubercles.

Testes.—Normal.

Eyes.—Normal.

Various Lymphatic Glands.

The Precurral Glands contained moderately numerous discrete yellow caseous nodules somewhat irregular in outline with narrow grey margins, the largest about the size of a hemp seed.

The Pudic, Iliac, Ilio-sacral, Popliteal, and Gluteal Glands contained similar nodules.

Several haemo-lymph glands contained discrete caseous nodules.

VIRUS P. XIV.

(July 13, 1905.)

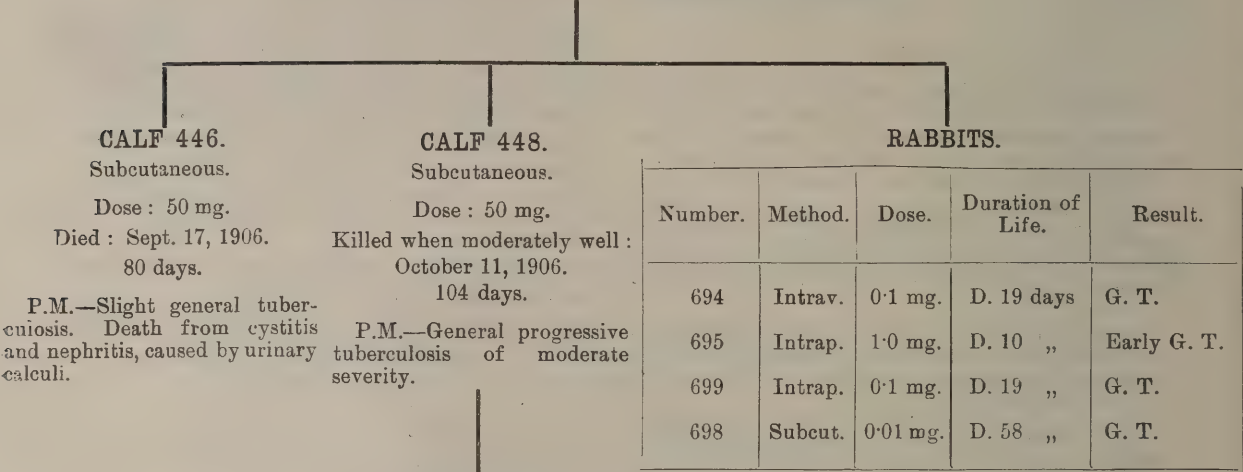
SUBMAXILLARY GLAND.

CULTURE INOCULATIONS.

(a) JUNE 29, 1906.

The strain was derived from the original material, through G.P. 1623, and had been in cultivation a total period of 290 days.

The culture used was the 12th generation, 21 days old.



VIRUS P. XIV.—*continued.*CULTURE INOCULATIONS—*continued.*

(b) APRIL 16, 1907.

The strain was derived from the original material, through G.P. 1623, and had been in cultivation a total period of 581 days.

The culture used was the 21st generation, 21 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1307	Intrav.	0.1 mg.	D. 67 days.	G. T.
1308	Subcut.	1.0 mg.	D. 72 „	G. T.
1292	Subcut.	10.0 mg.	D. 99 „	G. T.

CALF 532.

Subcutaneous.

Dose : 50 mg.

Died : July 1, 1907.

76 days.

P.M. — General tuberculosis; severe in the lungs.

CALF 534.

Subcutaneous.

Dose : 50 mg.

Killed : July 12, 1907.

87 days.

P.M. — General progressive tuberculosis of moderate severity.

CULTURE INOCULATIONS.

OCTOBER 14, 1907.

The strain was derived from the spleen of Calf 534, and had been in cultivation a total period of 94 days.

The culture used was the 4th generation, 21 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1518	Intrav.	1.0 mg.	D. 19 days	G. T.
1517	Intrav.	0.1 mg.	D. 17 „	G. T.
1519	Subcut.	10.0 mg.	D. 58 „	G. T.
1516	Subcut.	1.0 mg.	D. 80 „	G. T.

(c) JULY 16, 1907.

The strain was derived from the original material, through G.P. 1623, and had been in cultivation a total period of 672 days.

The culture used was the 23rd generation, 21 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1407	Intrav.	1.0 mg.	D. 21 days	G. T.
1406	Intrav.	0.1 mg.	D. 45 „	G. T.
1409	Subcut.	10.0 mg.	D. 201 „	G. T.
1408	Subcut.	1.0 mg.	D. 177 „	G. T.

CALF 446. Virus P. XIV.

Subcutaneous inoculation of culture derived from the original material of Virus P. XIV, through G.P. 1623.

Dose—50 milligrammes.

Date—June 29, 1906.

Weight at Inoculation—36.74 kilogrammes. [Age about 5 weeks.]

Died—September 17, 1906. [80 days after inoculation.]

Clinical Notes.

Seven days after inoculation on the left side of the neck there was a flat local thickening measuring 7.5 by 5 cm.; the adjacent prescapular gland was very slightly enlarged. On the fourteenth day a firm slightly raised tumour had developed, which measured 10 by 6 cm. The gland was slightly enlarged, 5 cm. in length.

On the fortieth day the local conditions were unchanged. The general condition of the calf was fair.

On the fifty-fifth day the tumour was firm and measured 11.5 by 6.2 cm., by about 7.5 cm. in thickness; the gland was 6 cm. in length. The calf was not in very good condition, and seemed a little weak, but there was no increase in the respiration, and the appetite was good. Three weeks later the local conditions were unchanged; the calf was thin but apparently not ill. Three days later it died.

Temperature.—The temperature was irregular during the experiment but was at no time very high, the maximum range of variation being from 38.2° C. to 39.8° C.

Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

			Kilogrammes.
June 29, 1906	...	...	36.74
September 17, 1906	...	...	34.01

Total loss of weight during experiment.—2.73 kilogrammes.

POST-MORTEM EXAMINATION.

General Condition.—Fair.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a firm flattened tumour measuring 11 by 5.7 cm., by 1.7 cm. in greatest thickness, composed of dense yellowish white caseo-necrotic tissue adherent both to skin and muscle but not infiltrating either to any extent.

Left Prescapular Gland.—The left prescapular gland measured 5.7 by 4 cm. by about 2 cm.; on section the greater part of the gland was composed of dense pinkish yellow caseated tissue showing no sign of calcification. A little normal gland tissue remained chiefly around the periphery and this contained more or less discrete yellow caseous tubercles.

Right Prescapular Gland.—The right prescapular gland contained one yellow caseous nodule 1.5 mm. in diameter.

Prepectoral Glands.—One on the left side, the size of a sparrow's egg, was dense yellow and caseous throughout; its capsule was thickened.

Other prepectoral glands were normal.

Left Cervical Glands.—One of the left lower cervical glands, a little over 1 cm. in diameter, was indurated and mottled with caseous foci which formed a more or less continuous line around the periphery of the gland; the capsule was much thickened.

A mid-cervical gland contained a yellow caseous focus.

The superior cervical gland contained a yellow caseous nodule a little larger than a millet seed.

Right Cervical Glands.—The right upper cervical gland contained one yellow pinhead tubercle. Other cervical glands on this side were normal.

Mastoid Glands.—The left showed at one extremity a group of yellow caseous tubercles. The right was normal.

Axillary Glands.—Normal.

Thorax.

Pleura.—The parietal pleura on the last few ribs on the right side showed a number of small connective tissue outgrowths, in the apices of which small hard tubercles, some caseous some hæmorrhagic, could be felt.

Lungs.—The lungs collapsed normally and showed scattered throughout, not very numerous, firm nodules ranging in size from a pin's head to a hemp seed; on section they were yellow and caseous, and in the majority of cases surrounded by a small angular dark red zone; they appeared to be most numerous in the caudal lobes. In the anterior lobes there were some large areas of collapse. In the posterior parts of the caudal lobes there were some small consolidated lobules which were either homogeneously red throughout or showed early caseous infiltration.

Thoracic Glands.—The bronchial and mediastinal glands were not apparently enlarged; they contained fairly numerous more or less discrete yellowish white caseous tubercles ranging up to about 2 mm. in diameter.

Heart.—Normal.

Abdomen.

The peritoneal cavity contained a small quantity of yellow turbid fluid suspended in which were flakes of yellow pus.

The bladder was greatly distended, the serous surface was markedly injected and covered with a layer of yellowish fibrino-purulent material. The serous membranes in contact with it, i.e. of the rumen and left kidney, were congested and covered with yellow fibrinous lymph. On incision the bladder was found to be filled with dark red bloody fluid, and to contain rather a large quantity of gravel. The mucous membrane was congested and deeply hæmorrhagic; the wall of the bladder was thickened.

Kidneys.—The left kidney was enlarged, the pelvis and calyces were dilated, their walls being thickened, and contained numerous concretions; the cortex was tough, most of the lobules showing on the surface a greyish mottled appearance; on section these grey areas extended into the cortex as radial streaks. In several places the cortex showed yellow purulent areas. The capsule stripped badly and the perirenal tissue was much increased in amount.

The right kidney was slightly larger than normal, and showed an oedematous condition of the pelvis and calyces, with a few scattered concretions. The surface was speckled with petechial hæmorrhages, and the cortex showed a marked increase of interstitial connective tissue, with here and there some greyish radial streaks.

No tubercles were seen in either kidney.

Suprarenal Bodies.—Normal.

Spleen.—The spleen was normal in size, and showed on section sparsely scattered firm yellowish tubercles, the largest the size of a millet seed.

Liver.—The liver appeared normal on the surface and on section.

Portal Glands.—The portal glands, little if at all enlarged, contained discrete firm yellow caseous nodules ranging in size from a pin's head to a hemp seed.

Coeliac Glands.—One coeliac gland was slightly enlarged, and closely beset with firm irregular yellow caseous nodules up to a hemp seed in size.

Lumbar Glands.—The lumbar glands were enlarged. The largest contained three or four yellow millet seed sized tubercles and a few smaller greyish yellow foci.

Alimentary Tract.

Tongue.—Normal.

Tonsils.—In one tonsil a soft yellow tubercle was found.

Submaxillary Glands.—Each contained three or four yellow caseous nodules, the largest 1·5 mm. in diameter.

Pharyngeal Glands.—Each contained numerous yellow caseous tubercles, the largest a little larger than a millet seed.

Intestines.—The terminal Peyer's patch of the small intestine contained about a dozen softened caseous nodules up to a hemp seed in size, over which the mucous membrane was congested and ulcerated. Another patch just in front of this contained one similar nodule. The large intestine was normal.

Mesenteric Glands.—The terminal mesenteric glands were slightly enlarged and showed on section firm yellow caseous masses which extensively replaced the gland substance; the other glands contained scattered caseous nodules up to about 1 cm. in diameter.

Ileo-colic Glands.—One ileo-colic gland showed several large caseous areas, another showed a small caseous patch.

Colic Glands.—Two colic glands were partly caseous.

Pharynx, Larynx.—Normal.

Testes.—Normal.

Eyes.—Normal.

Various Peripheral Lymphatic Glands.

Popliteal Glands.—The left showed in the cortex a pin-head sized yellow caseous tubercle. The right was normal.

Preaural Glands.—Normal.

Gluteal and Ischiatic Glands.—Normal.

Pudic Glands.—Normal.

Microscopic Examinations.

Tubercle from Tonsil.—Tubercle bacilli very numerous.

Tubercle from Lumbar Gland.—Three tubercle bacilli seen.

Tubercle from Intestine.—Tubercle bacilli very numerous.

CALF 448. Virus P. XIV.

Subcutaneous inoculation of culture derived from the original material of Virus P. XIV, through G.P. 1623.

Dose—50 milligrammes.

Date—June 29, 1906.

Weight at Inoculation—31·75 kilogrammes. [Age about 5 weeks.]

Killed when moderately well—October 11, 1906. [104 days after inoculation.]

Clinical Notes.

Seven days after inoculation on the left side of the neck there was a flat local thickening 7·5 by 5 cm. in area; the adjacent prescapular gland was very slightly enlarged. On the fourteenth day there was a slightly raised firm flattened local infiltration measuring 9 by 6 cm.; the prescapular gland was slightly enlarged, 5 cm. in length.

On the fortieth day the tumour at the seat of inoculation was small and slightly raised, measuring 9·5 by 5·5 cm.; the gland was 7·5 cm. in length. The left prepectoral gland was enlarged.

On the seventy-seventh day the tumour was smaller (7·5 by 4·5 cm.) and softening in the centre. The calf was thin, but not ill. Twenty-four days later it was killed; it was then in poor condition: there was some inspiratory dyspnoea and an occasional cough.

Temperature.—The temperature was irregular during the experiment, but at no time was it very high, the maximum range of variation being 1·8° C. (38·0° C.—39·8° C.).

Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

			Kilogrammes.
June 29, 1906	...	...	31·75
October 11, 1906	...	...	45·35

Total gain of weight during experiment.—13·60 kilogrammes.

Average rate of gain per week.—907 grammes.

POST-MORTEM EXAMINATION.

Carcass.—Condition fair.

Local Lesion.—At the seat of inoculation in the subcutaneous tissues of the left side of the neck there was a flattened pear-shaped tumour 8·3 by 5 by 2 cm. On section it consisted of yellow caseo-necrotic substance with scattered calcareous streaks; the centre was beginning to break down forming a small cavity. It was adherent to skin and muscle, in both of which there were scattered caseous tubercles.

Left Prescapular Gland.—The left prescapular gland measured 5·8 by 3 by 4 cm. On section about one third of the gland consisted of semi-translucent caseated tissue with yellowish white calcareous streaks. In the rest of the gland the cortex was in part caseous and in part contained discrete caseous tubercles. The medulla showed scattered caseous nodules.

Right Prescapular Gland.—Normal.

Prepectoral Glands.—A left prepectoral gland was replaced by caseated tissue, with yellow calcareous streaks and foci mainly around the periphery. A second gland was enlarged and had the cortex filled with confluent caseous gritty nodules. Right prepectoral glands normal.

Axillary Glands.—Normal.

Cervical Glands.—A left lower cervical gland was enlarged and caseous throughout with calcareous streaks. Of the left middle cervical glands one was almost entirely caseous and two others contained caseous nodules. The left superior cervical gland was normal. The right superior cervical gland contained a single irregular caseous nodule with calcareous foci. One right middle cervical contained two caseous nodules. The right inferior cervical gland was normal.

*Thorax.**Pleura and Diaphragm.*—Normal.

Lungs.—The anterior and middle lobes of the right lung contained numerous nodules which projected from the surface and measured up to 1 cm. in diameter. In places they had become confluent forming larger masses. The majority showed a tendency to soften and from some the whole soft caseous centre could be picked out, leaving a translucent capsule. In the lung substance between the nodules were dark congested areas. The posterior lobe presented much the same appearance, but in many parts the nodules had run together, forming large caseous masses. The softening was more marked, some being caseo-purulent throughout and showing the early stages of cavity formation.

The left lung was similar to the right except that in the centre of the posterior lobe there was a caseo-purulent mass replacing about one-third of the substance.

Thoracic Glands.—The long mediastinal gland was large and the greater part of the cortex was filled with irregular confluent caseo-calcareous nodules; the rest of the gland showed discrete tubercles and nodules. Two other mediastinal glands were more than half replaced by firm caseated tissue with calcareous streaks and foci.

The right bronchial glands were enlarged and almost entirely caseous. The left were filled with caseated tissue similar to that in the mediastinal glands.

Heart and Pericardium.—Normal.*Abdomen.**Omentum and Peritoneum.*—Normal.

Spleen.—The spleen weighed 141 grammes. Beneath the capsule could be seen scattered tubercles projecting slightly from the surface. On section the pulp contained moderately numerous discrete yellow caseous tubercles up to a hemp seed in size. The majority of these contained fine calcareous streaks in the centre.

Liver.—On the anterior convex surface there were three small slightly projecting tubercles with filmy marginal expansions. Just beneath the surface and sparsely scattered throughout the substance were tubercles varying from a grey point up to a millet seed. The largest were caseous with grey margins and gritty centres.

Portal Glands.—The portal glands (four in number) were enlarged and the cortices were closely filled with

firm caseous nodules with grey margins and yellow calcareous centres.

Kidneys.—In the cortices there were a few scattered minute grey foci and an occasional grey tubercle with an opaque calcareous centre.

Suprarenal Bodies.—The right showed two caseous tubercles the size of rape seed with calcareous centres. The left contained three similar tubercles.

Intestines.—In the first part of the small intestine there were scattered nodules up to 5 mm. in diameter occurring both in the Peyer's patches and in the mucous membrane. They projected internally and in the centres of some there were small openings. On section the majority consisted of soft caseous substance. The rest were of translucent tissue with soft yellow centres. In the lower part of the intestine only occasional nodules were met with in the Peyer's patches. One had a small ulcer in the centre, the base of which was formed by soft caseous tissue.

Mesenteric Glands.—The mesenteric glands contained numerous nodules varying in size from a pea to a pigeon's egg. They were separated from each other by normal gland tissue or tissue with a few caseous foci. The nodules consisted of a caseous network embedded in firm translucent tissue similar to that in the bronchial glands.

Colic Glands.—The colic glands were enlarged and their cortices were almost entirely replaced by a fibro-caseous network with calcareous foci.

Gastric Gland.—One gastric gland contained a caseous nodule.

The Tongue, Larynx, Pharynx, Tonsils, and Trachea were normal.

Special Glands.

Coeliac Glands.—One gland was replaced by confluent caseo-calcareous nodules. Two others showed irregular caseo calcareous tubercles.

Lumbar Gland.—One lumbar gland was filled with caseous gritty nodules.

Renal, Left Iliac, Right Precrural, Gluteal, Left Popliteal, Left Ischiatic, Posterior Pharyngeal Glands.—These glands contained a varying number of discrete caseous nodules.

Right Iliac, Left Precrural, Right Popliteal, and Left Parotid Glands were normal.

CALF 532. Virus P. XIV.

Subcutaneous inoculation of culture derived from the original material of Virus P. XIV, through Guinea-pig 1623.

Dose—50 milligrammes.

Date of Inoculation—April 16, 1907. [Age about 11 weeks.]

Died—July 1, 1907. [76 days after inoculation.]

Temperature.

The temperature began to rise about the 7th or 8th day after inoculation and reached 39.9 on the 17th day; subsequently there was irregular pyrexia (max. 39.9).

Weights.

				Kilogrammes.
April 16, 1907	...	...	...	39.90
July 1, 1907	...	...	...	39.90

POST-MORTEM EXAMINATION.

Condition.—Poor.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a tumour measuring 12.7 by 7.5 by 5 cm. On section it was found to be a cyst filled with a clear serous fluid with a few flakes and small masses of caseo-necrotic substance; the inner walls were shaggy and lined by a thin layer of caseo-necrotic substance slightly gritty. There was a little infiltration of both skin and muscle.

Left Prescapular Gland.—The left prescapular gland measured 8 by 3·8 by 3 cm., the periglandular tissue was oedematous. On section it showed about two-thirds of its cortex completely caseous with a tendency to central softening, and in the other third a close network of yellow caseous tissue.

Right Prescapular Gland.—The right prescapular gland measured 5 by 2·2 by 1·2 cm. On section it was congested and contained a few scattered caseous nodules and a small collection at one extremity.

Left Prepectoral Glands.—The left spherical prepectoral gland was enlarged and caseous throughout. The left reniform gland was enlarged and oedematous and showed the cortex beset with caseous tubercles.

Left Cervical Glands.—The left inferior cervical gland showed discrete caseous tubercles. The left superior cervical gland was oedematous and contained one small collection of caseous tubercles.

The Right Prepectoral and Cervical Glands were oedematous but contained no tubercles.

The Axillary Glands on both sides were oedematous but otherwise normal.

Thorax.

Pleura.—Normal.

The Tissues of the Posterior Mediastinum were markedly oedematous.

Lungs.—The lungs were voluminous and did not collapse; they were congested and the anterior lobes on both sides, the right lobe, and the ventral margins of the caudal lobes were solid and airless; they were reddish grey in colour and were fairly closely beset with yellow caseous nodules and patches. The posterior portions of the caudal lobes were also severely affected, containing large firm pneumonic patches beset with caseous nodules; in some of these whole lobules were caseous throughout.

Trachea.—Normal.

Thoracic Glands.—The long mediastinal gland was enlarged, measuring 10·5 by 3·2 by 2 cm. On section the cortex was firm and was closely beset, but not entirely replaced, by irregular waxy caseous nodules. The other mediastinal and bronchial glands were similar to the long mediastinal gland.

Heart and Great Vessels appeared normal.

Abdomen.

Omentum.—In the omentum there was one grey submiliary tubercle.

Peritoneum.—Normal.

Spleen.—The spleen weighed 70 grammes. On section it contained moderately numerous discrete yellow caseous nodules varying from a rape-seed up to a hemp seed in size; the majority were of the larger size and were softened in the centre.

Liver.—On the convex surface beneath the capsule there was one minute grey tubercle. On the inferior surface there were two caseating miliary tubercles.

On section through the substance there was an occasional minute grey tubercle.

The Gall Bladder was normal.

Portal Glands.—The cortices of the portal glands were closely filled with waxy caseous nodules up to a hemp seed in size.

Kidneys.—On the surface of both kidneys there were scattered foci of congestion. In one there was a grey miliary tubercle caseous in the centre and on section slightly elongated, and also a minute grey focus. On the surface of the other kidney there were four grey tubercles with caseous centres varying up to a millet seed; section revealed one more tubercle.

Suprarenal Bodies.—The suprarenal bodies were normal.

Lumbar Glands.—The lumbar glands contained discrete waxy caseous nodules.

Iliac Glands.—Normal.

Alimentary Tract.

Tongue, Tonsils, Larynx, and Pharynx.—Normal.

Large Intestine.—Normal.

Small Intestine.—In two of the Peyer's patches there were small ulcers with caseous floors.

Gastric Glands.—Several of the gastric glands showed the margins of the cortex caseous.

Mesenteric Glands.—Two or three of the mesenteric glands at each extremity of the mesentery were firm and almost replaced by a yellow caseous network. In the rest of the chain of glands there occurred at intervals caseous nodules varying in size from a wheat grain up to a nodule measuring 2 by 1·5 cm.

Various Lymphatic Glands.

Coeliac Glands.—The coeliac glands were to a considerable extent replaced by a network of yellow caseated tissue.

Submaxillary Glands.—The left submaxillary gland showed one hemp seed sized caseous nodule. The right was normal.

The Parotid Glands showed caseous nodules.

Precrural, Popliteal, Gluteal, Ischiatic, and Posterior Pharyngeal Glands.—Normal.

The caseous lesions showed a greater tendency to soften than to calcify.

Microscopical Examination.

(Smear Preparations.)

Tubercle from Liver.—A few tubercle bacilli.

Bronchial Gland.—Moderately numerous tubercle bacilli.

CALF 534. Virus P. XIV.

Subcutaneous inoculation of culture derived from the original material of Virus P. XIV. through Guinea-pig 1623.

Dose—50 milligrammes.

Date of Inoculation—April 16, 1907. [Age about 11 weeks.]

Killed—July 12, 1907. [87 days after inoculation.]

Temperature.

The temperature began to rise on the 10th day after inoculation, reaching 40·2 on the 14th, and remaining

above forty for four days; it then fell and subsequently fluctuated slightly above normal.

Tuberculin Test.

The calf was not tested during the experiment.

Weights.

			Kilogrammes.
April 16, 1907	...	...	54.87
July 12, 1907	...	...	72.10
<i>Total gain in weight.</i> —17.23 kilogrammes.			

POST-MORTEM EXAMINATION.

General Condition.—Good.

Local Lesion.—In the subcutaneous tissues on the left side of the neck there was an elongated tumour weighing with skin and muscle 396 grammes, and measuring 20 by 7.5 by 4 cm. On section it was found to be composed of caseo-necrotic gritty substance with an irregular central cavity containing serous fluid; it infiltrated both skin and muscle.

Left Prescapular Gland.—The left prescapular gland measured 9.5 by 5 by 4.5 cm. On section it was composed almost throughout of caseo-necrotic tissue with gritty foci; at one part there was some softening with the formation of a small cavity.

Right Prescapular Gland.—The right prescapular gland was normal.

Left Prepectoral Glands.—The left reniform prepectoral gland was enlarged and closely filled with caseous streaks and foci. The cortex of the left rounded prepectoral gland showed numerous caseous foci.

Cervical Glands.—The left inferior cervical gland was enlarged measuring 3.8 by 2.5 cm. On section about one-third of its cortex was replaced by a caseating gritty nodule; the remainder was firm grey and beset with caseous foci. The left middle and superior cervical glands were normal.

The Right Cervical Glands were normal.

The Right Prescapular and Right Prepectoral Glands were normal.

Thorax.

Pleura.—The lymphatic fringes in the intercostal spaces were enlarged and congested, and several of them contained flat grey translucent nodules.

Lungs.—The lungs did not collapse normally; they were crepitant, but a little congested and oedematous. Scattered throughout the substance were moderately numerous irregular grey nodules with a caseous network, varying considerably in size, the largest being about 2 by 3 cm. in area. The majority were surrounded by a zone of congestion.

Trachea.—Normal.

Thoracic Glands.—The long mediastinal gland measured 15 cm. in length by 4.3 cm. in greatest thickness; on section the cortex consisted of firm grey tissue with a yellowish caseous network slightly gritty in parts; the small amount of cortical tissue left was deeply congested. The other mediastinal glands were similar.

The Bronchial Glands resembled the mediastinal glands, but there was more firm grey tissue and less caseation.

A Gland at the Entrance to the Thorax on the left side contained a fine caseous yellowish network. One on the right showed a few opaque foci.

The Heart and Great Vessels appeared normal.

Diaphragm.—On the pleural surface of the diaphragm the lymphatic fringes were prominent, form-

ing shaggy grey growths in which could be felt minute hard grey tubercles; on the peritoneal surface there were a few nodules similar to those in the omentum.

Abdomen.

Omentum.—In the omentum there were scattered translucent nodules varying in size up to about a wheat grain; the largest were flattened and loosely attached, and a few were congested.

Peritoneum.—Normal.

Intestines.—The small intestine; in the first part in the mucous membrane there was a circular nodule 1 cm. in diameter with a crater-like ulcer and a caseous base. Along the intestine there were four similar but smaller nodules, two of them being in Peyer's patches.

In the large intestine there were two congested circular ulcers resembling those in the small gut.

The Mesenteric Glands were not severely affected; many of them showed large single firm grey nodules with a caseous gritty network.

Spleen.—The spleen weighed 170 grammes. On section it contained scattered nodules (30 counted) up to 5 mm. in diameter. On section these consisted of soft caseous substance enclosed within grey translucent capsules.

Liver.—On the ventral surface there were four slightly projecting nodules with fibrinous fringes: four flattened nodules were visible on the convex surface. Attached to the sharp margin but not affecting the substance, there was a pea sized grey nodule caseous in the centre. On section there were sparsely scattered throughout the substance nodules similar to those in the spleen and varying up to a hemp seed in size.

The Gall Bladder was normal.

Portal Glands.—The portal glands contained in the cortices discrete grey nodules caseous in the centre.

Kidneys.—The left kidney showed in the cortex just beneath the surface five minute opaque tubercles. The right kidney contained one tubercle. On section no more were revealed.

Suprarenal Bodies.—The left suprarenal body showed three submiliary caseous tubercles. The right suprarenal body was normal.

The Renal, Lumbar, and Iliac Glands were normal.

Tongue, Tonsils, Larynx, and Pharynx were normal.

Various Lymphatic Glands.

Coeliac Glands.—Three were normal; in a fourth the cortex was beset with caseous miliary tubercles.

The Precural, Right Gluteal, Popliteal, Submaxillary, Parotid, and Ischiatic Lymphatic Glands were normal.

The Left Gluteal Gland contained a few irregular caseous nodules.

Microscopical Examination.

(Smear Preparation.)

Ulcer from Large Intestine.—Moderately numerous tubercle bacilli.

CALF 536. Virus P. XIV.

Subcutaneous inoculation of culture derived from the lung of Calf 448.

Dose—50 milligrammes.

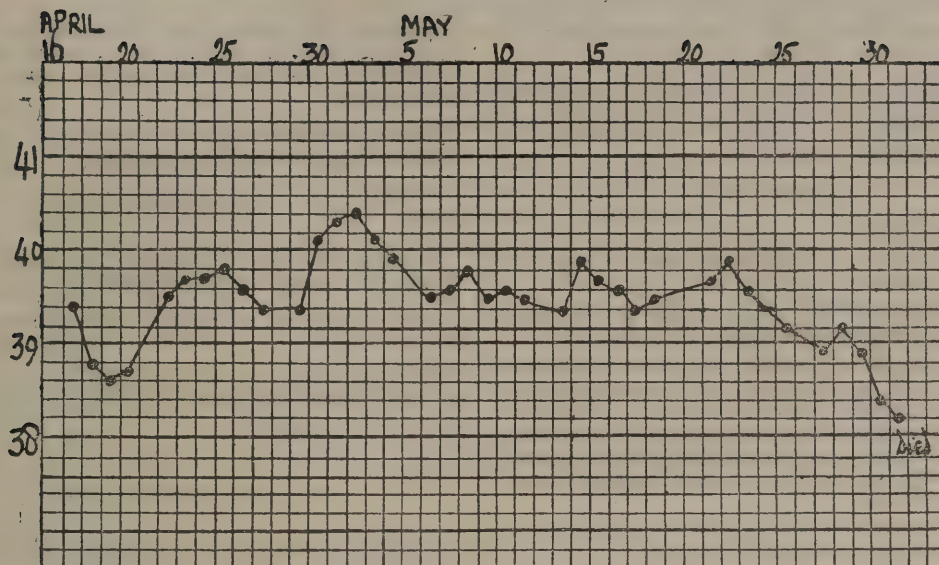
Date of Inoculation—April 16, 1907. [Age about 13 weeks.]

Died—June 1, 1907. [46 days after inoculation.]

Clinical Notes.

The course of the disease was similar to that usually seen in animals acutely infected.

Temperature.



Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

	Kilogrammes.
April 16, 1907	58.50
June 1, 1907	53.05

Total loss of weight.—5.45 kilogrammes.

POST-MORTEM EXAMINATION.

Carcass.—Emaciated.

Local Lesion.—The tumour at the seat of inoculation on the left side of the neck weighed with the attached skin and muscle 368 grammes, measuring 13.5 by 10 by 6.5 cm. It was in close proximity to and adherent to the gland, and the surrounding tissues were oedematous. On section the superficial half consisted of pinkish caseo-necrotic tissue, while the deeper part was composed of caseous tissue infiltrating the muscle and the oedematous tissues.

Left Prescapular Gland.—The left prescapular gland measured 8 by 4.6 by 4 cm. The tissues were adherent to the thickened capsule and on section the gland was composed throughout of firm caseo-necrotic tissue with scattered yellowish white gritty streaks.

Right Prescapular Gland.—The right prescapular gland measured 4.5 by 2 by 1.2 cm. On section it showed moderately numerous irregular caseous tubercles up to a hemp-seed in size, and also a few larger collections.

Left Prepectoral Glands.—The left round prepectoral gland, the size of a large pea, was diffusely caseous throughout. The left reniform gland contained discrete caseous nodules in the cortex.

Left Cervical Glands.—The left inferior cervical gland had nearly half the cortex diffusely caseous, while the rest was firm and contained numerous caseous foci. A second deeper gland was caseous throughout. A left middle cervical gland was diffusely caseous almost throughout.

The left superior cervical glands contained discrete irregular caseous nodules.

Right Prepectoral Glands.—A few hempseed sized nodules were found in the reniform gland, and smaller nodules in the rounded gland.

The Right Axillary, and the Superior, Middle, and Inferior Cervical Glands were similar to the right prescapular gland. The left axillary gland contained numerous irregular caseous nodules up to 4 mm.

Thorax.

Pleura.—On the pleural surface of the pericardium there was a single flattened congested nodule. On the parietal pleura there were ten flattened nodules varying in size up to 10 mm.

Lungs.—The lungs were large and did not collapse normally. The substance was closely filled with caseous tubercles with grey margins, for the most part discrete and measuring up to 2 mm. They were most numerous in the anterior and middle lobes where there was considerable lobular congestion, although there still remained a fair amount of normal lung tissue. The ventral part of the right posterior lobe was much more congested, quite airless, and sank in water.

Trachea.—Down the trachea there were a dozen flattened congested nodules with caseous centres.

Thoracic Glands.—The long mediastinal gland measured 15 by 4.5 by 2.3 cm. On section almost the whole cortex was composed of firm grey tissue with a close caseous network. The other mediastinal glands were similar. The remaining part of the cortices of these glands was deeply congested and contained caseous foci.

The bronchial glands were enlarged and resembled the long mediastinal gland.

The glands within the entrance to the thorax on the left side showed the cortices firm and in a condition of early caseation. Those on the right side, and the ventral mediastinal glands, showed numerous irregular caseating nodules with grey margins.

Heart and Great Vessels.—Normal.

Abdomen.

Omentum.—On the omentum there were moderately numerous flattened nodules up to 3 mm. in diameter. The majority were loosely attached, many were deeply congested; they were firm and translucent and almost all showed some caseation in the centre.

Peritoneum.—On the parietal peritoneum there were four flat grey nodules.

Spleen.—The spleen weighed 255 grammes. The vessels on the capsule were injected and there was one flattened grey nodule. On section the substance was closely filled with yellowish caseous nodules with grey margins, varying up to a hempseed in size.

Liver.—The surface of the liver was studded with numerous grey tubercles with irregular caseous centres varying up to 1.5 mm. Some projected from the surface and were flattened and mushroomed. On section the substance showed similar tubercles distributed throughout.

Gall Bladder.—The vessels of the mucous membrane of the gall bladder were injected; on it were two caseous tubercles, and a number of congested spots the centres of which were a little firm; these were not definite tubercles.

Portal Glands.—The portal glands were large and the greater part of the cortices was replaced by a network of caseated tissue.

Kidneys.—The cortices of the kidneys, on the

surface and on section, showed scattered grey tubercles with opaque centres up to 1.5 mm. in diameter.

Suprarenal Bodies.—The right was normal; the left showed one opaque submiliary tubercle.

Lumbar, Iliac, and Renal Glands.—The lumbar and iliac glands contained numerous caseous nodules. In the renal glands these had become confluent, almost entirely replacing the gland tissue.

Alimentary Tract.

Tongue.—Normal.

Tonsils.—In the tonsils there was a moderate number of caseous tubercles.

On the laryngeal surface of the epiglottis there was a congested circular ulcer 3 mm. in diameter.

Small Intestines.—Beneath the mucous membrane along the whole length of the small intestine, mainly in Peyer's patches, there were fairly numerous irregular caseous tubercles varying up to a rapeseed in size but here and there attaining the size of a hempseed. Over many there was a small aperture in the mucous membrane.

Large Intestine.—In the large intestine many of the solitary follicles were opaque in the centre.

Gastric Glands.—These glands contained irregular caseous nodules.

Mesenteric Glands.—The mesenteric glands were somewhat enlarged and contained numerous irregular caseous nodules surrounded by firm grey tissue.

Genito-Urinary Systems.

Testes.—Each testis showed a caseous miliary tubercle.

Various Lymphatic Glands.

Coeliac.—The coeliac glands were enlarged. In the largest the cortex was replaced by a caseous network, and the three small ones were similarly though rather less affected.

Precural Glands.—Showed a moderate number of irregular caseous nodules up to 3 mm.

Pudic Glands.—Enlarged and similar to the precural.

Popliteal, Gluteal, Ischiatic, and Parotideal Glands all contained irregular caseous nodules.

Retro-pharyngeal Glands.—Closely filled with caseous nodules.

Submaxillary Glands.—The left contained numerous irregular caseous nodules up to 4 mm. in diameter. The right was similar.

Microscopical Examinations.

Foci from Trachea.—Tubercle bacilli numerous.

Nodule from Epiglottis.—Tubercle bacilli scanty.

Focus from Testis.—Tubercle bacilli numerous.

Nodule from Small Intestine.—Tubercle bacilli numerous.

Follicle of Large Intestine.—Tubercle bacilli numerous.

Congested Mucous Membrane of Gall Bladder.—Two tubercle bacilli seen.

CALF 538. Virus P. XIV.

Subcutaneous inoculation of culture derived from the lung of Calf 448.

Dose—50 milligrammes.

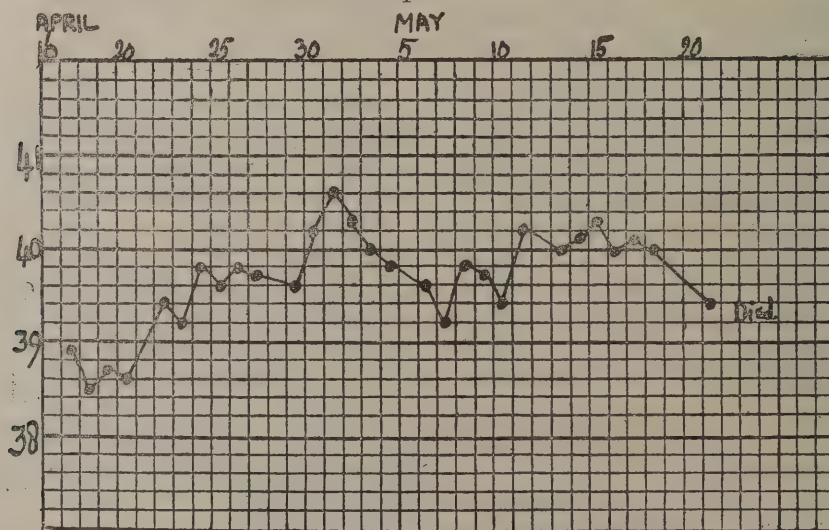
Date of Inoculation—April 16, 1907. [Age about 7 weeks.]

Died—May 22, 1907. [32 days after inoculation.]

Clinical Notes.

The course of the disease was similar to that usually seen in animals suffering from acute tuberculosis.

Temperature.



Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights

			Kilogrammes.
April 16, 1907	...	...	43.99
May 22, 1907	...	...	39.00
Total loss of weight.—4.99 kilogrammes.			

POST-MORTEM EXAMINATION.

Carcass emaciated.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a slightly prominent tumour measuring 16 by 8 by 5 cm. and weighing 396 grammes. It was adherent to and infiltrated the skin and muscle

around. On section it was composed of firm pinkish grey caseo-necrotic tissue. At one extremity of the tumour there was a small cavity containing clear serous fluid.

Left Prescapular Gland.—The left prescapular gland measured 11 by 5.5 by 5.5 cm. and weighed 170 grammes. On section it was composed throughout of dense pinkish yellow necrotic tissue. The capsule was thickened and adherent to the muscles.

The tissues and muscles around the local tumour and prescapular gland were greatly thickened and oedematous, and contained numerous caseous foci and nodules.

Right Prescapular Gland.—The right prescapular gland measured 5 by 2 by 1 cm. On section it was found to contain a moderate number of yellow caseous nodules 5 mm. in diameter.

Left Prepectoral Glands.—These glands were enlarged and contained a few caseating nodules in the cortices.

Cervical Glands.—The left inferior cervical gland was composed practically throughout of dense yellow necrotic tissue similar to that of the left prescapular gland.

The left middle and left upper cervical glands were firm and congested, and showed in the cortices a close network of yellow caseating tissue.

The right cervical glands contained a few irregular caseous tubercles.

Axillary Glands.—The left showed two yellow caseous nodules 5 mm. in diameter. The right contained a few small nodules with caseous foci.

Right Prepectoral Glands.—These were similar to the right axillary gland.

Thorax.

Pleura.—The lymphatic fringes along the margins of the ribs were congested, and showed numerous minute grey tubercles.

On the caval fold and on the right side of the pleural surface of the diaphragm there were some congested fringes containing minute grey tubercles.

Lungs.—The lungs were very heavy. The left cephalic and right middle lobes and the ventral portions of the right cephalic lobe were dark red and hepatised. There were a few large patches of congestion in the caudal lobes. The lung parenchyma was closely beset with grey and translucent tubercles with opaque caseous centres, ranging in size from a mere point up to 4 mm. in diameter, the larger ones being formed by the aggregation of a few small tubercles.

The trachea showed a few congested caseous foci. Some of the smaller bronchi were blocked by yellow purulent material.

Thoracic Glands.—The mediastinal glands were enlarged, firm, and hæmorrhagic, and showed in their cortices about half of the substance replaced by a network of grey nodules with caseous foci.

The bronchial glands were similarly affected.

A gland at the entrance to the thorax was composed practically throughout of pinkish yellow necrotic tissue, the capsule of the gland being thickened.

Heart.—There were two grey tubercles in the heart muscle.

Abdomen.

Omentum.—On the inferior surface of the omentum there were moderately numerous nodules up to a hemp seed in size, some of which were deeply congested, with caseous centres; others were grey and translucent.

Peritoneum.—On the peritoneal surface of the diaphragm there was one flattened grey nodule with a caseous centre.

The rest of the peritoneum was normal.

Spleen.—The spleen weighed 198 grammes. It was normal on the surface; on section it was closely beset with caseating tubercles 2 to 3 mm. in diameter.

Liver.—The surface of the liver was closely beset with grey tubercles with caseous centres, ranging in size from about 0.5 up to 3 and 4 mm. On section similar tubercles were seen throughout the substance.

Gall Bladder.—In the gall-bladder there were five submucous caseous tubercles the size of pin heads.

Portal Glands.—The cortices of the portal glands were closely beset with small irregular greyish yellow caseating tubercles in places forming a close network.

Kidneys.—Each kidney showed in the cortex moderately numerous grey translucent tubercles, the majority having opaque centres ranging in size from a mere point to a millet seed.

Suprarenals.—The left showed one, the right five, small grey tubercles with minute caseous centres.

Iliac, Lumbar, and Renal Glands.—These showed a moderate number of irregular caseous tubercles up to 4 mm. in diameter.

Alimentary Tract.

Tongue.—Normal.

Tonsils.—Each tonsil contained one or two small caseous foci.

There was one flattened nodule on the epiglottis.

Intestines.—The small intestine showed just beneath the mucous membrane a moderate number of small caseous tubercles; these were most numerous towards the ileum. A few of the lymphoid follicles of the large intestine were caseous.

Gastric Glands.—These glands showed a moderate number of yellow caseating tubercles.

Mesenteric Glands.—All the mesenteric glands showed a moderate number of yellow caseating nodules.

Colic and Ileo-colic Glands.—These showed a few small caseous tubercles.

Genito-Urinary System.

Testes.—Normal.

Urinary Bladder.—There were four small tubercles with caseous centres in the bladder.

Various Lymphatic Glands.

Submaxillary, Parotid, and Retro-pharyngeal.—These glands showed a moderate number of discrete caseating tubercles ranging in size from a mere point to that of a millet seed.

Coeliac.—The coeliac glands showed in the cortices a greyish yellow caseous network and a few discrete nodules.

Pudic.—The pudic glands were deeply congested, and contained a moderate number of irregular caseating tubercles.

Precural, Popliteal, Gluteal, Ischiatic.—Each showed a few discrete caseating tubercles.

Microscopical Examinations.

Suprarenal body, tubercle from.—A few tubercle bacilli seen.

Heart, tubercle from.—No tubercle bacilli seen.

Emulsion of Prescapular Gland.—Numerous tubercle bacilli.

VIRUS P. XXIX.

(December 20, 1905.)

SUBMAXILLARY GLANDS.

CULTURE INOCULATIONS, JANUARY 7, 1907.

The strain was derived from the original material, and had been in cultivation
a total period of 383 days.

The culture used was the 12th generation, 24 days old.

CALF 454.

Intravenous.

Dose : 50 mg.

Died : Jan. 23, 1907.

16 days.

P.M.—General Tuberculosis.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
820	Intrav.	0.1 mg.	D. 17 days.	G. T.
824	Intrap.	1.0 mg.	D. 18 "	G. T.
825	Intrap.	0.1 mg.	D. 29 "	G. T.
821	Subcut.	1.0 mg.	D. 75 "	G. T.
822	Subcut.	0.1 mg.	D. 126 "	G. T.
823	Subcut.	0.01 mg.	D. 80 "	G. T.

CALF 454. Virus P. XXIX.

Intravenous inoculation (also partly subcutaneous) of culture derived from original material of
Virus P. XXIX.

Dose—50 milligrammes.

Date—January 7, 1907.

Weight at Inoculation—131.98 kilogrammes. [Age about 8½ months.]

Died—January 23, 1907. [16 days after inoculation.]

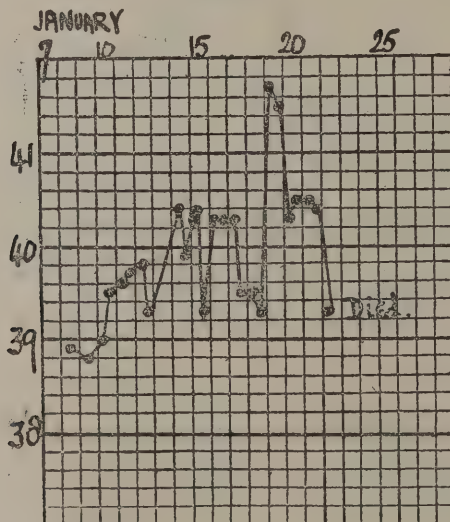
Clinical Notes.

The injection was begun in the vein (median) of the left ear, but owing to the restiveness of the animal the needle came out several times and finally the right ear was used. About 60 milligrammes of culture were used, part of which was lost and part went beneath the skin.

Two days later the calf was noticed to be always

lying down ; appetite good. On the third day it was very quiet, was breathing quickly (54 per minute), and panting a little ; its urine was not so abundant. On the tenth day the respirations were laboured (60 per minute) ; the animal's nose was hot, and it lay down a great deal.

On the 14th day it was breathing hard, and looked ill and thin ; two days later the difficulty in breathing had become more evident (70 per minute), and the animal died during the day.

Temperature.

Tuberculin Test.—The calf was not tested subsequent to inoculation.

Weights.

				Kilogrammes.
January 7, 1907	...	...	...	131.98
January 23, 1907	...	...	...	97.04

Total loss of weight during experiment.—34.94 kilogrammes.

POST-MORTEM EXAMINATION.

General Condition.—Very thin.

Local Lesions.—In the subcutaneous tissues of each ear at the seat of inoculation there was a patch of yellowish necrotic substance.

Parotid Lymphatic Glands.—About half of each parotid gland was replaced by greyish early caseous substance which in parts was becoming distinctly yellow.

Thorax.

Lungs.—The lungs weighed 5.78 kilogrammes. They were large and did not collapse normally. There was considerable subpleural emphysema on the dorsal surface of the lungs, but none on the ventral surface. The tongue-shaped lobe of the right lung was reddish grey and almost completely solid; the free half of it sank in water; on section it was found to be closely packed with minute irregular grey foci. In the attached half, which floated in water, there were small parts of the lung in which the foci were not quite so numerous. Part of the middle lobe was solid and presented a similar appearance. Similarly the anterior and ventral portions of the left lung were dark, congested, and in parts airless, and on section they presented the same appearance. The rest of the substance of the lungs, that is the greater part, was oedematous but not airless, and was closely filled with minute grey foci varying slightly in number in different lobules.

Bronchial and Mediastinal Glands.—The caudal mediastinal gland was enlarged, measuring 11.5 by 5 by 2.5 cm. The cortex was firm and the outer part closely filled with small irregular grey patches becoming discrete as it extends inwards, so that there was almost a complete thin margin of early caseation.

The next mediastinal gland was firm and congested and showed numerous similar irregular grey patches

forming a network. A third gland showed a similar early caseous margin and network. The smaller mediastinal glands were congested and showed grey foci.

The bronchial glands resembled the mediastinal.

Pleura.—Normal.

Heart.—Normal.

The tissues around the heart were very emphysematous, there was also considerable emphysema of the posterior mediastinum.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—The spleen weighed 541 grammes. There was a tendency to become diffuent, otherwise nothing abnormal could be seen.

Liver.—On section of the liver the cut surface showed the interlobular grey network well marked. No tubercles were seen in the organ.

Kidneys.—The kidneys showed on the surfaces alternate pale and congested patches. In the pale areas there were sparsely scattered minute irregular hæmorrhagic foci.

Suprarenal bodies.—Normal.

Renal, Lumbar, and Iliac Glands.—Normal.

Portal Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Intestines.—The small intestine was deeply congested in the greater part of its extent. The large intestine was normal.

Mesenteric Glands.—Normal.

Various Lymphatic Glands.

Pharyngeal, Submaxillary, Preaural, Popliteal, Gluteal, Ischiatic, Prescapular, Axillary.—No tubercles seen.

[The glands on the left side of the neck and shoulder were all dark and congested. The tissues between the muscles of the neck showed dilated small vessels—congestion due to hanging of the animal's head during life.]

VIRUS P. XLI.
(May 24, 1906.)

SUBMAXILLARY GLAND.

CULTURE INOCULATIONS.

I.—NOVEMBER 15, 1906.

The strain was derived from the original material, and had been in cultivation a total period of 175 days.

The culture used was the 8th generation, 21 days old.

FOWL 128.

Intravenous, 15 mg.

Killed : 103 days.

Moderately numerous grey foci in liver. No other tuberculosis.

CALF 478.

Subcutaneous.

Dose : 50 mg.

Killed : Feb. 22, 1907.
99 days.

Fibrous-walled cyst at seat of inoculation. The prescapular gland contained caseo-calcareous nodules; near it was a small tuberculous nodule. No tuberculosis elsewhere.

RABBITS.

CALF 480.

Subcutaneous.

Dose : 100 mg.

Killed : Feb. 21, 1907.
98 days.

Fibrous-walled cyst at seat of inoculation. In the left prescapular gland were two caseo-calcareous nodules; the left prepectoral gland showed caseo-calcareous streaks. A few scattered grey tubercles were seen in the liver.

Number.	Method.	Dose.	Duration of Life.	Result.
1052	Intrav.	1.0 mg.	D. 11 days.	No visible lesions. T.B. in organs.
1051	Intrav.	0.1 mg.	K. 99 "	Slight T. of lungs, kidneys, and left testis.
1054	Intrap.	10.0 mg	K. 99 "	Slight T. of peritoneum, kidneys, lungs, and thoracic glands.
1053	Intrap.	1.0 mg.	D. 23 "	Early G.T.
1056	Subcut.	50.0 mg.	D. 45 "	Large septic local ulcer. Slight T. of lungs.
1055	Subcut.	10.0 mg.	K. 99 "	Local lesion. Slight T. of lungs.

VIRUS P. XLI.
SUBMAXILLARY GLAND

II.—JANUARY 24, 1907.

The strain was derived from the original material, and had been in cultivation a total period of 245 days.

The culture used was the 10th generation, 21 days old.

FIG 172.

Fed.

Dose : 50 mg.

Killed : May 3, 1907.

98 days.

P.M.—Caseous nodules in the submaxillary and mesenteric glands. A few grey tubercles in lungs and on diaphragm. One tubercle in the liver and a few in portal glands. No tuberculosis elsewhere.

FOWL 186.

Intraperitoneal.

Dose : 100 mg.

Killed : 68 days.

Tuberculous peritonitis only.

FIG 166.

Subcutaneous.

Dose : 50 mg.

Killed : May 7, 1907.

102 days.

P.M.—At seat of inoculation the skin showed healing ulcers. Left inguinal and sternal glands partly caseous. Severe tuberculous consolidation of the lungs. A few nodules in the kidneys; and one in the spleen.

CULTURE.

September 20, 1907.

The strain was derived from the lung and had been in cultivation a total period of 136 days.

The culture used was the 7th generation, 20 days old.

FIG 202.

Subcutaneous.

Dose : 50 mg.

Died : November 23, 1907.

64 days.

P.M.—At seat of inoculation there was a subcutaneous cyst filled with caseous pus. Right inguinal and sternal glands caseous. Severe tuberculous consolidation of the lungs. A few tubercles in bronchial and mediastinal glands. A few pale areas in kidneys. No tuberculosis elsewhere.

Emulsion of Lung.

FIG 228.

Subcutaneous.

Dose : 9.0 cc.

Killed : May 7, 1908.

166 days.

P.M.—Cyst at seat of inoculation. Caseous nodules in the inguinal glands. The lungs showed a few minute translucent foci. A tubercle in a portal gland. No disease elsewhere.

CULTURE.

March 12, 1908.

The strain was derived from the lung and had been in cultivation a total period of 110 days.

The culture used was the 7th generation, 16 days old.

FIG 258.

Subcutaneous.

Dose : 50 mg.

Died : June 23, 1908.

103 days.

P.M.—Cyst filled with soft caseous substance at the seat of inoculation. Caseation of left inguinal and sternal glands. Lungs solid except for the dorsal surfaces; partly grey and translucent, partly reddish. Bronchial glands firm (T.B. numerous). A few foci in the kidneys. Various lymphatic glands showed opaque patches.

CULTURE.

The strain was derived from the lung and had been in cultivation a total period of 35 days.

The culture used was the 2nd generation, 21 days old.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1861	Intrav.	0.01 mg.	K. 100 days.	Slight T. of lungs and kidneys.
1862	Intrav.	0.1 mg.	K. 101 "	Slight G.T.
1863	Intrav.	1.0 mg.	D. 27 "	G.T.
1864	Subcut.	38 mg.	K. 100 "	Local lesion and slight T. of lungs.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1212	Intrav.	1.0 mg.	D. 3 days.	No T.
1213	Intrap.	1.0 mg.	D. 40 "	T. of peritoneum. Slight T. of lungs and kidneys. Death from other causes.
1214	Subcut.	100.0 mg.	D. 24 "	Local lesion only. Death from other causes.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1481	Intrav.	1.0 mg.	K. 129 days	Slight T. of lungs and kidneys.
1479	Intrav.	0.1 mg.	K. 129 "	Slight T. of lungs and kidneys.
1480	Subcut.	50.0 mg.	K. 146 "	Local T. only.
1478	Subcut.	10.0 mg.	K. 146 "	Local T. only.

RABBITS.

Number.	Method.	Dose.	Duration of Life.	Result.
1701	Subcut.	50 mg.	K. 174 days.	Cystic local lesions. Slight T. of lungs and kidneys.
1702	Subcut.	50 mg.	K. 174 "	Cystic local lesion. Nodules in nearest glands.

CALF 478. Virus P. XLI.

Subcutaneous inoculation of culture derived from the original material of Virus P. XLI.

Dose—50 milligrammes.

Date of Inoculation—November 15, 1906.

Weight at Inoculation—73·48 kilogrammes. [Age about 18 weeks.]

Killed when in good health—February 22, 1907. [99 days after inoculation.]

Clinical Notes.

14 days after inoculation on the left side of the neck there was a prominent tumour firm and adherent to the skin, measuring 12·5 by 9 cm. The left prescapular gland was considerably enlarged, measuring 10 by 5 cm.

Both the tumour and gland slowly diminished in size, and the former became soft and fluctuating; on the 54th day it measured 10 by 6·3 cm. The calf remained well during the experiment.

Temperature.—The temperature rose to 39·9° C. on the 13th day. At the close of the third week it had returned to the normal, and it remained normal subsequently.

Tuberculin Test.—February 19th, 96 days after inoculation. Positive reaction. Rise of temperature, 2·0° C.

Weights.

	Kilogrammes.
November 15, 1906	73·48
February 22, 1907	96·14

Total gain of weight.—22·66 kilogrammes.

Rate of gain per week.—1·62 kilogrammes.

POST-MORTEM EXAMINATION.

General Condition.—Good.

Local Lesion.—At the seat of inoculation on the left side of the neck there was a prominent tumour measuring 14 by 8·3 by 7 cm. and weighing 453 grammes. On section it consisted of a thick fibrous-walled cyst distended with a mucoid caseo-purulent substance.

Left Prescapular Gland.—The left prescapular gland measured 7 by 3 by 1·5 cm. On section it contained a caseo-calcareous nodule 1·5 by 0·75 cm.; two slightly smaller nodules consisting of soft slightly gritty caseous substance; and also, just beneath the capsule, scattered tubercles, some soft and caseous, others caseo-calcareous.

Near the prescapular gland was a small pear-shaped nodule 1·75 cm. in length.

Right Prescapular Gland (6 by 3 cm.).—Normal.

Pectoral and Axillary Glands.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—Normal.

Thoracic Glands.—Normal.

Heart.—Normal.

Abdomen.

Peritoneum.—Normal.

Spleen (368 grammes).—Normal.

Liver.—The liver contained beneath the capsule and in the substance numerous closely placed irregular grey nodules, the majority with a yellowish tint and many surrounded by congested areas and foci. They varied in size up to roughly 5 mm. in greatest diameter. On section they were soft.

Portal and Coeliac Glands.—Normal

Kidneys.—Normal.

Suprarenal Bodies.—Normal.

Renal, Lumbar, and Iliac Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Submaxillary, Pharyngeal, Hyoid, and Parotid Glands.—Normal.

Intestines.—Normal.

Mesenteric Glands.—Normal.

Testes.—Normal.

Eyes.—Normal.

Various Lymphatic Glands.

Preaural, Popliteal, Gluteal, Ischiatic, Pudic.—Normal.

Microscopic Examinations.

Smear from Liver.—No tubercle bacilli.

Emulsion of Liver Tissue.—No tubercle bacilli.

Emulsion of nodule near Prescapular Gland.—Tubercle bacilli in moderate numbers.

CALF 480. Virus P. XLI.

Subcutaneous inoculation of culture derived from the original material of Virus P. XLI.

Dose—100 milligrammes.

Date of Inoculation—November 15, 1906.

Weight at Inoculation—68·90 kilogrammes. [Age about 17 weeks.]

Killed when in good health—February 21, 1907. [98 days after inoculation.]

Clinical Notes.

14 days after inoculation on the left side of the neck there was a prominent rounded tumour, adherent to the skin and infiltrating the subjacent muscles, and measuring 15·3 by 12·5 cm. The dependent tissues were oedematous. The left prescapular gland was not palpable, being overlapped by the tumour.

On the 35th day the tumour measured 10 by 7 cm.; it was soft in the centre and firm round the margins. The prescapular gland was now quite evident, and measured 9 cm. in length.

The tumour afterwards became soft and fluctuating all over, but did not ulcerate. The gland diminished in size until it was no larger than its fellow on the right side.

Temperature.—There was a period of slight pyrexia

commencing on the 12th day after inoculation, and lasting a week. The highest temperature recorded during this period was 40.1° C. Subsequently the temperature remained normal.

Tuberculin Test.—February 19, 96 days after inoculation. Slight reaction. Rise of temperature 0.8° C.

Weights.

	Kilogrammes.
November 15, 1906	68.90
February 21, 1907	98.40

Total gain of weight.—29.50 kilogrammes.

Rate of gain per week.—2.10 kilogrammes.

POST-MORTEM EXAMINATION.

General Condition.—Good.

Local Lesion.—In the subcutaneous tissues on the left side of the neck there was a tumour measuring 10 by 7.5 by 5 cm. On section it consisted of a cyst filled with turbid fluid in which masses of curdy caseous substance were floating; it was lined by grey granulation tissue to which flocculi were adherent. It did not infiltrate either skin or muscle.

Left Prescapular Gland.—The left prescapular gland measured 7.5 by 3.5 by 1.3 cm. On section it contained a caseo-calcareous nodule 2.5 by 1.3 cm. and a second the size of a pea; otherwise the gland was normal.

Prepectoral Glands.—The rounded prepectoral gland on the left side was slightly enlarged and firm, containing a network of translucent tissue with caseo-calcareous streaks. Other prepectoral glands were normal.

Right Prescapular Gland.—Normal.

Axillary Glands.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—Normal.

Thoracic Glands.—Normal.

Heart.—Normal.

Abdomen.

Peritoneum.—Normal.

Spleen.—Normal.

Liver.—On the surface of the liver just beneath the capsule about seven scattered grey slightly irregular tubercles were seen, not larger than a rape seed. On section they were soft and could be picked out. An occasional focus was seen on section in the substance of the liver.

Gall Bladder.—Normal.

Portal Glands.—Normal.

Kidneys.—Normal.

Suprarenal Bodies.—Normal.

Renal, Lumbar, Iliac, and Coeliac Glands.—Normal

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Pharyngeal, Submaxillary, Hyoid, and Parotid Glands.—Normal.

Intestines.—Normal.

Mesenteric Glands.—Two showed foci of congestion, otherwise the glands were normal.

Testes.—Normal.

Eyes.—Normal.

Various Lymphatic Glands.

Precrural, Popliteal, Gluteal, Ischiatic, Pudic.—Normal.

Microscopic Examinations.

Liver, Tubercle from.—No tubercle bacilli seen.

Prepectoral Gland, Emulsion of.—No tubercle bacilli seen.

PIG 166. Virus P. XLI.

Subcutaneous inoculation of culture derived from the original material of P. XLI.

Dose—50 milligrammes.

Date of Inoculation—January 25, 1907. [Age 8 weeks.]

Killed when in good health—May 7, 1907. [102 days after inoculation.]

Clinical Notes.

In the subcutaneous tissues 18 days after inoculation there was a rounded prominent soft tumour 6.5 cm. in diameter; this ulcerated after 84 days and discharged soft caseous substance.

Temperature.—The temperature during the whole of the experiment varied very little, at no time rising above 39.7° C.

Tuberculin Test.—74 days after inoculation. Positive: Rise of temperature 2.7° C.

Weight at Death.—31.29 kilogrammes.

POST-MORTEM EXAMINATION.

General Condition.—Good.

Local Lesion.—At the seat of inoculation to the left of the umbilicus the skin over an area 3.8 cm. square was pigmented and brownish red; in it there were two small ulcers with thin overhanging margins, from which a little pus could be expressed, and also two pigmented papillae, which, on section, were fibrous and

obviously a consequence of healed ulcers. The skin on the under surface was thickened, fibrous, and pigmented; there were in the subcutaneous tissues two small sinuses in connection with the ulcers, and scattered soft yellow gritty miliary nodules within grey fibrous capsules.

Left Inguinal Glands.—One left inguinal gland measured 3 by 2 cm. and contained a nodule, replacing nearly half its substance, and consisting of soft yellow caseo-pus, which could be evacuated, leaving a smooth pinkish grey wall; in the other half of the gland there was a pea-sized nodule similarly constituted, and in the substance between were a few opaque yellowish tubercles. Three other glands were a little firm but otherwise normal.

Right Inguinal Glands.—The glands on the right side were normal.

Left Ventral Mediastinal Gland.—The left ventral mediastinal gland was enlarged, and about half replaced by yellow caseo-purulent substance similar to that in the left inguinal gland.

Precrural Glands.—The precrural glands on both sides were normal.

Thorax.

Pleura.—The lymphatic fringes on the parietal pleura were prominent; along these were moderately numerous flat fibroid nodules, some in the fringes, others loosely attached to the pleura. At the apex of the right pleural cavity there was an area of parietal pleura fairly thickly sown with small hard grey tubercles; the largest were up to a wheat grain in size and several were opaque and yellowish in the centre.

Lungs.—The lungs did not collapse normally. The right posterior lobe showed on the surface, more markedly in the posterior half, numerous raised irregular translucent nodules, varying when discrete up to about 3 mm. in diameter; they extended a little way into the substance. In addition there were similar nodules beneath the pleura not raised from the surface. The two sets were so close together as to form a coarse network of grey nodules. Around the margins of the lobes the nodules had run together, so that the margins were hard and nodular in places nearly 2 cm. in width. On section through the lung substance there were scattered discrete grey miliary tubercles. In the right anterior lobe there was the same distribution of grey nodules on the surface, but also the whole of the right anterior lobe was firm, grey, and solid and sank in water. The middle tongue-shaped piece was about half grey and solid. The left posterior lobe resembled the right, but the nodules were even more closely placed, leaving only small islands of pink lung tissue. The left anterior lobe and the middle tongue-shaped piece were almost entirely grey and solid and sank in water. Nowhere was there any definite caseation, but occasionally there was some slight central opacity in the nodules, and more especially in the discrete tubercles.

The Large Bronchi and the Great Vessels about the Heart were normal.

The Small Bronchi and Bronchioles in the solid grey areas were filled with muco-purulent fluid.

The Bronchial and Dorsal Mediastinal Glands were normal in appearance.

Trachea.—Normal.

Heart.—Normal.

Diaphragm.—The lymphatic fringes on the pleural surface of the diaphragm were prominent, and several of them contained hard flat translucent grey nodules, slightly irregular but roughly the area of a millet seed. On the right side of the peritoneal surface of the diaphragm there were about thirty somewhat flattened translucent nodules, similar to those on the pleural surface; one was a little opaque in the centre. On the left side there were three similar nodules.

Abdomen.

Omentum.—Normal.

Peritoneum.—Normal.

Large and Small Intestines.—Normal.

Mesenteric Glands.—Normal.

Spleen.—In the spleen there was a single yellowish tubercle a little larger than a millet seed, which on section was caseous in the centre.

Liver.—Normal.

Portal Glands.—Normal.

Kidneys.—In the cortices of the kidneys there were moderately numerous discrete grey nodules, yellowish towards the centre. On section they extended a short way through the cortex as a streak; the largest was about the size of a millet seed. A few were met with in the medulla.

Suprarenal Bodies.—In the right suprarenal body there was a firm grey tubercle, opaque in the centre, the size of a rape seed. The left suprarenal body was normal.

The Coeliac, Lumbar, and Iliac Glands were normal.

Alimentary Tract.

Tongue, Tonsils, Larynx, and Pharynx.—Normal.

Various Lymphatic Glands.

Prescapular, Prepectoral, Cervical, Submaxillary, and Parotid Lymphatic Glands were normal.

*Microscopical Examinations.**(Smear Preparations.)*

Nodule on Diaphragm.—No tubercle bacilli found.

Pneumonic Lung Substance.—Four tubercle bacilli seen.

Muco-pus from Bronchiole.—Three tubercle bacilli seen.

Marginal Nodule from Lung.—A moderate number of tubercle bacilli.

Right Suprarenal Body Nodule.—No tubercle bacilli found.

Right Kidney Nodule.—No tubercle bacilli found.

Bronchial Gland Substance.—Two tubercle bacilli seen.

Animals Inoculated.

Three guinea-pigs inoculated with an emulsion of the muscle remained healthy. Guinea-pigs inoculated with emulsions of the lung, liver, spleen, and kidney became tuberculous.

PIG 172. Virus P. XLI.

Fed once with culture derived from the original material of Virus P. XLI.

Dose—50 milligrammes.

Date of Feeding—January 25th, 1907.

Killed in good health—May 3, 1907. [98 days after feeding.]

Clinical History.

There was no sign of illness during the experiment.

Temperature.—The temperature remained normal throughout.

Tuberculin Test.—74 days after feeding. Positive. Rise of temperature 2.3° C.

Weight at death.—32.19 kilogrammes.

POST-MORTEM EXAMINATION.

General Condition.—Good.

Tongue.—Normal.

Tonsils.—Normal.

Pharynx.—Normal.

Submaxillary Glands.—Left submaxillary glands. Two small glands were normal. A third was enlarged and contained about a dozen discrete nodules up to 3 mm., which easily shelled out of the surrounding gland tissue; they consisted of grey tissue becoming opaque towards the centre where there were whitish slightly gritty streaks and foci.

Right submaxillary glands. One was normal. A

second was enlarged and contained about fourteen nodules, similar to those on the other side, up to 5 mm. in diameter.

Pharyngeal Glands.—Normal.

Cervical Glands.—Normal.

Abdomen.

Peritoneum.—Normal.

Omentum.—Normal.

Stomach.—Normal.

Intestines.—Small intestine normal. Large intestine showed the follicles prominent, otherwise normal.

Gastric Glands.—Normal.

Mesenteric Glands.—Almost all the mesenteric glands were beset with irregular waxy caseous nodules with fine opaque white streaks in the centre; they varied in size up to a small pea, the majority being about the size of a hemp seed; they shelled out leaving smooth walled cavities in apparently normal gland tissue.

Spleen.—Normal.

Liver.—In the liver just beneath the capsule there was a yellow caseous tubercle within a grey capsule rather larger than a millet seed.

Portal Glands.—In one portal gland there was one opaque spherical tubercle the size of a rape seed; in a second gland there were five similar tubercles which were soft and not appreciably gritty; the rest were normal.

Kidneys.—In the cortex of the left kidney there was a pale area with the surface slightly depressed below the normal level and the substance a little firmer than the rest of the kidney.

The right kidney appeared normal.

Suprarenal Bodies.—Normal.

Renal, Lumbar, and Iliac Glands.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—On the surface of the lungs just beneath the pleura there were a few scattered minute translucent tubercles (eight counted), one slightly opaque in the centre; there were also two rather larger, the size of millet seeds, and perfectly translucent. Section of lungs revealed no more.

Thoracic Glands appeared normal.

Pericardium.—Normal.

Heart.—Normal.

Diaphragm.—On the left side of the diaphragm on the abdominal surface there were about thirty fibroid translucent hard nodules somewhat flattened; the majority were of the size of millet seeds, but a single large one measured 4 mm. in diameter.

Testes.—Normal.

Prescapular, Prepectoral, Parotid, Cervical, Gluteal, Preaural, Inguinal, and Popliteal Lymphatic Glands appeared normal.

Microscopical Examinations.

(Smear Preparations.)

Lung, Small Tubercle.—No tubercle bacilli seen.

Lung, Large Tubercle.—No tubercle bacilli seen.

Diaphragm (Nodule).—No tubercle bacilli seen.

Follicle of Large Intestine.—No tubercle bacilli seen.

Liver Tubercle.—No tubercle bacilli seen.

Portal Gland Tubercle.—One tubercle bacillus seen.

Animals Inoculated.

Four guinea-pigs from the muscle, and one from the kidney, remained healthy.

Two guinea-pigs from the mesenteric glands became tuberculous.

FIG 202. Virus P. XLI.

Subcutaneous inoculation of culture derived from the lung of Pig 166.

Dose—50 milligrammes.

Date of Inoculation—September 20, 1907. [Age 19·5 weeks.]

Died—November 23, 1907. [64 days after inoculation.]

Temperature.

The temperature remained normal until the fifty-ninth day, five days before death, when it rose slightly, reaching 40·3° C. on the sixty-second day.

Tuberculin Test.

October 29, 1907. 39 days after the experiment began. Dose of tuberculin (Avian) 4·0 cc. Rise of temperature 0·4° C.

Weights.

			Kilogrammes.
September 20, 1907	...	...	29·02
November 23, 1907	...	...	29·02

POST-MORTEM EXAMINATION.

Local Lesion.—In the subcutaneous tissues on the right side of the abdomen there was a circular tumour 6 cm. in diameter. On section it was found to be a cyst filled with caseo-purulent substance. It was

adherent to the muscle in which was a number of discrete soft caseous miliary tubercles.

Inguinal Glands.—One right inguinal gland was enlarged and almost entirely replaced by softening caseous slightly gritty substance. A second gland contained two caseous tubercles.

The left inguinal glands were normal.

Thorax.

Lungs.—The lungs were heavy and did not collapse; the substance was firm. The anterior lobes were, except for emphysematous margins, reddish grey and airless. On section the solid lung substance was beset with discrete caseous gritty granules. The posterior lobes were extensively consolidated and presented a similar appearance; the pneumonic tissue was however not continuous, leaving small islands of crepitant lung tissue.

Thoracic Lymphatic Glands.—The bronchial and mediastinal glands contained sparsely-distributed minute opaque caseous tubercles. The right ventral mediastinal gland was enlarged and entirely replaced by softening caseous slightly gritty substance.

Abdomen.

Spleen.—Normal.

Liver.—Normal.

Kidneys.—In the cortices of the kidneys there were some areas slightly paler than the rest of the substance.

There was no tuberculosis of any other organ or gland in the body.

Microscopical Examinations.

(Smear Preparations.)

Lung (grey patch).—A moderate number of tubercle bacilli.

Spleen (substance).—No tubercle bacilli.

Liver (substance).—No tubercle bacilli.

Kidney (substance).—A few tubercle bacilli.

FIG 228. Virus P. XLI.

Subcutaneous inoculation of an emulsion of lung of Pig 202.

Dose—9·0 cubic centimetres.

Date of Inoculation—November 23, 1907. [Age 14·5 weeks.]

Killed when in good general health—May 7, 1908. [166 days after inoculation.]

Temperature.

The temperature remained normal during the experiment.

Tuberculin Test.

January 31, 1908. [69 days after the experiment began.] Dose of tuberculin (Bovine), 2·0 cc. Rise of temperature, 0·7° C.

Weights.

			Kilogrammes.
November 25, 1907	...	...	19·95
May 7, 1908	...	...	63·49

Total gain in weight.—44·04 kilos.

POST-MORTEM EXAMINATION.

Carcass in good condition.

Local Lesion.—In the subcutaneous tissues on the right side of the abdomen there was a tumour about the size of a hen's egg, which on section was a fibrous walled cyst filled with soft caseous substance containing gritty foci.

Inguinal Glands.—One right inguinal gland contained a softening caseo-necrotic nodule 1 cm. in diameter. In the other right inguinal glands there

were a few soft caseous tubercles. A left inguinal gland contained a softening caseous nodule 6 mm. in diameter; the rest were normal.

Thorax.

Lungs.—In the lungs, which were pink and crepitant, there were beneath the pleura scattered minute translucent foci and a few translucent nodules up to a wheat grain in size (parasitic). There was also an occasional grey tubercle with an opaque centre.

Abdomen.

Spleen.—Normal.

Liver.—Normal.

Portal Glands.—In one portal gland there was a minute opaque calcareous tubercle.

There was no tuberculosis elsewhere in the body.

Microscopical Examinations.

(Smear preparations.)

Lung (translucent nodule).—No tubercle bacilli.

Lung (opaque nodule).—No tubercle bacilli.

FIG 258. Virus P. XLI.

Subcutaneous inoculation of culture derived from the lung of Pig 202.

Dose—50 milligrammes.

Date of Inoculation—March 12, 1908. [Age 15·5 weeks.]

Died—June 23, 1908. [103 days after inoculation.]

Clinical History.

The animal did not grow, remaining the same size as when it was inoculated. It was listless and was usually lying down; its appetite was poor. The breathing was rapid during the last weeks of life.

Temperature.

The temperature reached 40·1° Centigrade on the 23rd day and then quickly fell; it remained normal until shortly before death. Its highest point (40·6°) was reached 3 days before death.

Weights.

			Kilogrammes.
March 12th, 1908	...	...	18·14
June 23rd, 1908	...	...	15·42

Total loss in weight.—2·62 kilogrammes.

POST-MORTEM EXAMINATION.

General condition poor.

Local Lesion.—In the subcutaneous tissues of the abdomen to the left of the umbilicus, there was a baggy cyst about the size of a goose's egg; the skin

over it was intact and the tumour could be readily dissected from the under surface. On section it was filled with shreds of necrotic substance and yellow caseo-pus.

Inguinal Glands.—One left inguinal gland the size of a pigeon's egg, and a second half that size, both consisted of thin walled cysts filled with caseo-pus. In two or three smaller glands the centres of the lymphoid follicles were irregular, opaque, and greyish white; some were a little firmer than the surrounding tissue, others were softer.

The right inguinal glands resembled the small glands on the left side.

Precrural Glands.—The precrural glands were beset with ill-defined opaque, yellowish-white patches.

Thorax.

Lungs.—The convex dorsal surfaces of the posterior lobes were alone air-containing, and just sustained the lungs in water, the anterior and inferior portions of the posterior being quite solid. On section the solid portions of the lungs presented a mottled appearance, the lobules consisting of greyish translucent tissue with occasional soft yellowish foci surrounded by reddish pneumonic lung tissue. In the anterior lobes the greater part was fibroid tissue; in the posterior the fibroid and pneumonic tissues were about equal. The crepitant portions of the lungs, small in amount, contained discrete nodules similar to those described above.

The lymphatic fringes on the surfaces of the lungs were prominent.

Thoracic Lymphatic Glands.—The bronchial glands were a little firmer than normal, and showed greyish-white streaks and foci.

The left ventral mediastinal gland was enlarged to

about the size of a partridge's egg and consisted of a cyst filled with caseo-pus.

Abdomen.

Mesenteric Glands.—The majority of the mesenteric glands were normal in appearance, several showed opaque yellowish foci just beneath the capsules.

Intestines.—Normal.

Spleen.—Normal.

Liver.—The liver was congested, but otherwise normal.

Kidneys.—In the cortices of the kidneys there were scattered minute perfectly translucent foci.

Suprarenal Bodies.—Normal.

Various Lymphatic Glands.—The lumbar, iliac, pre-scapular, and the majority of the submaxillary glands contained opaque patches consisting of a definite caseous network.

Tonsils.—The tonsils showed a few foci of soft yellowish substance.

Tongue, Larynx, Pharynx, and Trachea.—Normal.

Microscopical Examinations.

(Smear preparations.)

Lung.—Very numerous tubercle bacilli.

Spleen.—Moderately numerous tubercle bacilli.

Inguinal Gland.—Numerous tubercle bacilli.

Bronchial Gland.—Numerous tubercle bacilli.

Lumbar Gland.—A few tubercle bacilli.

Precrural Gland.—A few tubercle bacilli.

Tonsil.—A few tubercle bacilli.

VIRUS P. XLVI.

(July 2, 1906.)

SUBMAXILLARY GLAND.

CULTURE INOCULATIONS.

I.—November 15, 1906.

The strain was derived from the original material, and had been in cultivation for a total period of 136 days.

The culture used was the 7th generation, 21 days old.

CALF 484.		CALF 486.		RABBITS.	
Subcutaneous.		Subcutaneous.			
Dose : 50 mg.		Dose : 75 mg.			
Killed : Feb. 25, 1907.		Killed : Feb. 28, 1907.			
102 days.		105 days.			
Fibrous - walled cyst filled with caseo-pus at seat of inoculation. In the left prescapular gland was a single caseous and softened nodule. The liver showed some irregular grey foci.		Fibrous-walled cyst at seat of inoculation. The left prescapular gland contained a single fibro-caseous nodule. One prepectoral gland showed a caseo-calcareous nodule. Two bronchial glands contained minute foci.			
Number.	Method.	Dose.	Duration of Life.	Result.	
1045	Intrav.	1·0 mg.	K. 100 days	Slight T. of lungs, kidneys, spleen, and mamma.	
1046	Intrav.	0·1 mg.	K. 100 "	Slight T. of lungs, kidneys, spleen, and liver.	
1048	Intrap.	10·0 mg.	K. 100 "	Slight T. of peritoneum, kidneys, and lungs. One tubercle in liver.	
1047	Intrap.	1·0 mg.	K. 100 "	Slight T. of peritoneum, kidneys, and lungs. One tubercle in spleen.	
1050	Subcut.	60·0 mg.	K. 100 "	Local lesion. One tubercle in lung.	

II.—January 24, 1907.

The strain was derived from the original material, and had been in cultivation for a total period of 206 days.

The culture used was the 9th generation, 21 days old.

FIG 164.	FIG 168.
Subcutaneous.	Fed.
Dose : 50 mg.	Dose : 50 mg.
Killed : May 2, 1907.	Killed : March 26, 1907.
97 days.	60 days.
P.M. — Two minute ulcers and caseo-purulent cyst at seat of inoculation. Caseation of left inguinal and sternal glands. Four small tubercles in the lungs. No tuberculosis elsewhere.	P.M. — Caseation of submaxillary, mesenteric and colic glands. A few translucent tubercles in the lungs. No tuberculosis elsewhere.

CALF 484. Virus P. XLVI.

Subcutaneous inoculation of culture derived from the original material of Virus P. XLVI

Dose—50 milligrammes.

Date of Inoculation—November 15th, 1906.

Weight at Inoculation—48·50 kilogrammes. [Age about 10 weeks.]

Killed when in good health—February 25th, 1907. [102 days after inoculation.]

Clinical Notes.

14 days after inoculation on the left side of the neck there was a pear-shaped tumour measuring 15·2 by 8·3 cm., adherent to skin and to the left prescapular gland, which was enlarged and measured 9 by 4·5 cm.

Subsequently the tumour decreased considerably in size and became soft and fluctuating; the gland also diminished, until on the 75th day it was no larger than the corresponding gland on the opposite side. At this time the tumour was the size of a hen's egg. The calf remained well during the experiment. It was killed on the 102nd day after inoculation.

Temperature.—On the 11th day the temperature rose to 39·6° C., reaching a maximum of 40·4° C. on the 14th day. It then slowly fell to normal, and remained normal during the remaining period of the experiment.

Tuberculin Test.—February 19th, 96 days after inoculation. Positive reaction. Rise of temperature, 1·0° C.

Weights.

				Kilogrammes.
Nov. 15, 1906...	...	...	...	48·50
Feb. 25, 1907...	...	...	...	64·39

Total gain of weight.—15·89 kilogrammes.

Rate of gain per week.—1·09 kilogramme.

POST-MORTEM EXAMINATION.

General Condition.—Good.

Local Lesion.—The tumour at the seat of inoculation on the left side of the neck measured 7·5 by 5 by 3·5 cm. On section it consisted of a fibrous-walled cyst lined by granulation tissue and filled with caseous pus.

Left Prescapular Gland.—The left prescapular gland measured 5·7 by 2 cm. On section it contained a single nodule 1 cm. in diameter, which consisted of soft caseous substance within a thin translucent capsule.

The Right Prescapular Gland, 5·5 cm. in length, was normal.

Prepectoral and Axillary Glands.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs, except for minute congested foci, appeared normal.

Thoracic Glands.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—Normal.

Liver.—In the liver there were sparsely scattered irregular grey foci.

Gall-Bladder.—Normal.

Portal Glands.—Normal.

Kidneys.—Normal.

Suprarenal Bodies.—Normal.

Renal, Lumbar, and Iliac Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Pharyngeal, Submaxillary, Hyoid, and Parotid Glands.—Normal.

Intestines and Mesenteric Glands.—Normal.

Testes.—Normal.

Eyes.—Normal.

Various Lymphatic Glands.

Preaural, Popliteal, Gluteal, Ischiatic, Pudic.—Normal.

Microscopical Examination.

(Smear preparations.)

Foci from Liver. { (1) One tubercle bacillus seen.
(2) No tubercle bacilli seen.

CALF 486. Virus P. XLVI.

Subcutaneous inoculation of culture derived from the original material of Virus P. XLVI.

Dose—75 milligrammes.

Date of Inoculation—November 15th, 1906.

Weight at Inoculation—51·70 kilogrammes. [Age about 12 weeks.]

Killed when in good health—February 28th, 1907. [105 days after inoculation.]

Clinical Notes.

14 days after inoculation on the left side of the neck there was an ill-defined local tumour, measuring about 15 by 11·5 cm.; it was prominent at the central part, where it showed a tendency to soften. The left prescapular gland was enlarged, 10 cm. in length.

Subsequently the tumour and gland (like those of Calf 484) decreased considerably in size. On the 75th day the former consisted of a prominent fluctuating bag measuring 9·5 by 5·6 cm.; and the

latter was only slightly enlarged. The calf remained well during the experiment.

Temperature.—On the 12th day the temperature rose to 39·7° C., and reached 40·2° C. on the 14th day. By the end of the third week it had regained the normal, and it remained normal until the animal was killed.

Tuberculin Test.—February 19, 1907. 96 days after inoculation. Positive reaction. Rise of temperature, 1·5° C.

Weights.

	Kilogrammes.
November 15, 1906	51.70
February 28, 1907	73.01

Total gain of weight.—21.31 kilogrammes.

Rate of gain per week.—1.42 kilogramme.

POST-MORTEM EXAMINATION.

General Condition.—Good.

Local Lesion.—At the seat of inoculation on the left side of the neck was a somewhat prominent tumour measuring 10 by 7 by 5 cm. On section it consisted of a fibrous-walled cyst containing turbid fluid, with flakes of caseous substance. It did not infiltrate either skin or muscle.

Left Prescapular Gland.—The left prescapular gland measured 5 by 3.7 by 1.5 cm. On section it contained a single fibro-caseous gritty nodule in the cortex measuring 2 by 1 cm.

Right Prescapular Gland.—The right prescapular gland measured 4.5 by 2.2 by 1 cm. It was normal on section.

Prepectoral Glands.—In the round prepectoral gland on the left side there was a nodule composed of caseo-calcareous grains. Other prepectoral glands were normal.

Axillary Glands.—Normal.

Thorax.

Pleura.—On the right side of the pleural cavity there was a small firm adhesion which, on section, was found to be a parasitic cyst.

Lungs.—Normal.

Thoracic Glands.—In two tracheo-bronchial glands there were minute discrete soft opaque foci.

Abdomen.

Peritoneum.—Normal.

Spleen.—Normal, weighed 226 grammes.

Liver.—Normal, except for a parasitic nodule.

Kidneys.—Normal.

Suprarenal Bodies.—Normal.

Renal, Lumbar, and Iliac Glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils.—Normal.

Pharyngeal, Submaxillary, Hyoid, and Parotid Glands.—Normal.

Intestines.—Normal.

Mesenteric Glands.—Normal.

Testes.—Normal.

Eyes.—Normal.

Various Lymphatic Glands.

Precrural, Popliteal, Gluteal, Ischiatic, Pubic.—Normal.

Microscopical Examination.

Foci from Tracheo-bronchial Gland.—No tubercle bacilli seen.

PIG 164. Virus P. XLVI.

Subcutaneous inoculation of culture derived from the original material of Virus P. XLVI.

Dose—50 milligrammes.

Date of Inoculation—January 25, 1907. [Age 8 weeks.]

Killed when in good health—May 2, 1907. [97 days after inoculation.]

Clinical Notes.

In the subcutaneous tissues, 18 days after inoculation, there was a prominent very soft tumour, which subsequently ulcerated and discharged.

Temperature.—The temperature remained fairly steady during the experiment, the highest temperature recorded being 39.7° C.

Tuberculin Test.—74 days after inoculation. Positive. Rise of temperature 2.4° C.

Weight at death.—28.11 kilogrammes.

POST-MORTEM EXAMINATION.

General Condition.—Good.

Local Lesion.—In the skin at the seat of inoculation to the left of the middle line of the abdomen there was some puckering with signs of previous distension at one part and two minute ulcers. To one side of these, just beneath the skin, which was thinned, there was a small cyst containing caseo-pus. In the subcutaneous tissue and in the muscle there were scattered discrete opaque tubercles, some minute, others up to a hemp seed in size; they were caseous and gritty and surrounded by grey capsules. There was some cicatricial tissue on the under side of the skin.

Left Inguinal Glands.—One gland was normal. A second gland was enlarged and half filled with caseous gritty tubercles forming a close network. In the rest of the gland there were discrete caseous gritty miliary tubercles and a caseo-necrotic mass which easily shelled out, leaving congested smooth walls.

Right Inguinal Glands.—Normal.

Left Ventral Mediastinal Gland.—In the left ventral mediastinal gland there were numerous tubercles arranged around the cortex; they were irregular, opaque, and caseous, with gritty centres, and about the size of millet seeds; they were easily picked out from the gland substance.

Precrural Glands.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—On the surface of each lung there were two perfectly translucent foci, and also two minute opaque yellow calcareous tubercles within grey translucent capsules. There were in the margins a few irregular dark red collapsed patches.

Thoracic Glands.—Normal.

Abdomen.

Omentum.—Normal.

Peritoneum.—Normal.

Spleen.—Normal.

Liver.—Normal.

Portal Glands.—Normal.

Kidneys.—Normal.

Suprarenal Bodies.—Normal.

Intestines.—Normal.

Mesenteric Glands.—Normal.

Renal, Lumbar, and Iliac Glands.—Normal.

Tongue, Pharynx, Larynx, Tonsils.—Normal.

Various Lymphatic Glands.

Pharyngeal, Submaxillary, Parotid, Prescapular and Cervical Glands.—Normal.

Popliteal and Gluteal Glands.—Normal.

Microscopical Examinations.

(Smear Preparations.)

Lung Tubercle.—No tubercle bacilli seen; other organisms present.

Left Inguinal Gland.—A few tubercle bacilli seen.

FIG 168. Virus P. XLVI.

Fed once with culture derived from the original material of Virus P. XLVI.

Dose—50 milligrammes.

Date of Feeding—January 25, 1907. [Age 8 weeks.]

Killed—March 26, 1907. [60 days after feeding.]

Clinical History.

No signs of illhealth were noticed during the experiment.

Temperature.—The temperature remained normal throughout.

Tuberculin Test.—The pig was not tested subsequent to feeding.

Weights.—The animal was not weighed before or during the experiment.

POST-MORTEM EXAMINATION.

General Condition.—The pig was in good condition when killed on account of a prolapse of rectum.

Tongue.—Normal.

Tonsils.—Normal.

Pharynx.—Normal.

Submaxillary Glands.—A submaxillary gland on the left side measuring 2 by 1.5 cm. was a little firm and on section was beset with irregular caseous tubercles up to a rape seed in size, which when picked out left a translucent capsule; other small glands were normal.

On the right side there were two submaxillary glands a little firm. One was the same size as, the other smaller than, that on the left; both on section contained similar but rather larger tubercles.

Pharyngeal Glands.—Normal.

Cervical Glands.—Normal.

Abdomen.

Peritoneum.—Normal.

Omentum.—Normal.

Stomach.—Normal.

Intestines.—The small intestine was normal. The large intestine was congested in patches.

Gastric Glands.—Normal.

Mesenteric Glands.—All the mesenteric glands showed moderately numerous irregular discrete waxy

caseous nodules similar to but larger than those in the submaxillary glands; some attained nearly the size of a hemp seed. On section they showed streaks slightly more opaque but not appreciably gritty.

Colic Glands.—The majority of the numerous colic glands showed caseous foci.

Spleen.—Normal.

Liver.—Normal.

Portal Glands.—Normal.

Kidneys.—Normal.

Suprarenal Bodies.—Normal.

Renal Lymphatic Glands.—Normal.

Coeliac, Iliac, and Lumbar Lymphatic Glands.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—On the surface of the lungs beneath the pleura there were sparsely scattered minute translucent tubercles (6 counted). One showed an opaque centre from which a smear was made.

The Bronchial Glands were normal.

Pericardium.—Normal.

Heart.—Normal.

Various Lymphatic Glands.

Prescapular, Prepectoral, Axillary, Parotid, Pre-cervical, Inguinal, Gluteal, and Popliteal Lymphatic Glands were normal.

Microscopical Examinations.

(Smear Preparations.)

Tubercle from Lung.—No tubercle bacilli seen.

Tonsil Secretion.—No tubercle bacilli seen.

Focus from Colic Gland.—No tubercle bacilli seen.

Nodule from Mesenteric Gland.—No tubercle bacilli seen.

IMMUNITY EXPERIMENTS

BY

A. STANLEY GRIFFITH, M.D. AND F. GRIFFITH, M.B.

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IMMUNITY EXPERIMENTS.

INTRODUCTION.

THIS report gives the results of certain experiments on immunity performed in accordance with the instructions of the Commission.

The object of the experiments was the investigation of the production of immunity in calves by the inoculation of living tubercle bacilli. Sixteen animals were used in the series; twelve received preliminary vaccinations, ten with bacilli of human origin, and two with bacilli of bovine origin, and were subsequently tested as to their resistance by the subcutaneous inoculation of a large dose (50 milligrammes) of bovine tubercle bacilli; four were inoculated with 50 milligrammes of bovine tubercle bacilli alone and served as controls.

The human cultures used for the preliminary vaccinations* were obtained from Viruses H 8. "S.C.," H 54. "C.W.," and H 56. "F.T.," and had been shown to be slightly virulent for the calf and rabbit. The resistance-test inoculations and the four control vaccinations were made with a culture derived from the tuberculous bronchial gland of a cow (Virus B XXVI).†

All the animals which had not succumbed were killed three months after the resistance-test inoculation.

DETAILS OF THE EXPERIMENTS AND GENERAL RESULTS.

For the purposes of description the experiments are divided into two sets, one containing the animals which received a single protective inoculation, the other those which received two protective inoculations.

In the first set, two calves, Nos. 1027 and 1017 were inoculated intravenously with 10 milligrammes of a slightly virulent culture (Virus H 8. "S.C.") and 63 days later were inoculated subcutaneously with 50 milligrammes of bovine tubercle bacilli.

Calf 1027 died in 46 days of acute tuberculosis; the lungs were extensively consolidated and beset with nodules; the thoracic glands were tuberculous; the liver and kidneys contained scattered miliary tubercles; there were numerous tubercles on the pleura, and a few on the omentum, and many of the abdominal lymphatic glands contained tubercles.

Calf 1017 was killed, when well, 95 days after the test inoculation; the lungs contained sparsely scattered calcareous tubercles and there were a few grey foci in the liver and a few gritty points in an omental gland.

Two calves, Nos. 1023 and 1025 were inoculated subcutaneously with 50 milligrammes of the same slightly virulent culture (Virus H 8. "S.C."), and 63 days later subcutaneously with 50 milligrammes of bovine bacilli; they were killed 92 and 91 days after the test inoculation and showed internally slight tuberculosis of the lungs and thoracic glands, and in one case a single tubercle in a mesenteric gland and one in a colic gland.

Two calves, Nos. 414 and 416 were inoculated subcutaneously with 0.001 milligramme of bovine bacilli (Virus B.XXVI.), and 51 days after with 50 milligrammes of the same bovine virus.

No. 414 died in 87 days from some unascertained cause and showed a few tubercles in the thoracic glands and a few in the spleen.

No. 416 was killed 89 days after the last inoculation and showed disseminated tuberculosis, moderately severe and apparently progressing in the thorax, very slight and obviously retrogressive in other organs.

The two controls, Nos. 418 and 422, belonging to this set, died of general progressive tuberculosis in 76 and 44 days respectively.

In the second set, two calves, Nos. 1039 and 1043, were inoculated intravenously with 10 milligrammes of a slightly virulent culture (Virus H 8. "S.C.") followed 63 days later by 1.0 milligramme of bovine culture subcutaneously; 51

days after the last inoculation 50 milligrammes of bovine culture were inoculated subcutaneously.

Calf 1039 was killed, when well, 93 days after the test inoculation and showed very slight tuberculosis of the lung (?), thoracic glands and liver.

Calf 1043 died in 53 days, apparently from diarrhoea; about a dozen hemp-seed sized caseating nodules were found in the lungs and one dry cheesy nodule in the liver.

Two calves, Nos. 1033 and 1035, were inoculated subcutaneously with 50 milligrammes of a slightly virulent culture (Virus H 8. "S.C."), followed 55 days later by 50 milligrammes of Virus H 56, "F.T." intravenously; 59 days after the last inoculation 50 milligrammes of bovine culture were inoculated subcutaneously.

Calf 1035 was killed, when well, 91 days after the last inoculation, and showed several nodules in the lung, three tubercles in the spleen, one in the liver, and a few caseous foci in the thoracic glands.

Calf 1033 was killed, when well, 90 days after the last inoculation and only a few small tubercles were found in the lungs.

Two calves, Nos. 923 and 925, were inoculated subcutaneously with 10 milligrammes of Virus H 54. "C.W.," followed 181 days later by 50 milligrammes of Virus H 8. "S.C."; 63 days after the last inoculation 50 milligrammes of bovine tubercle bacilli were inoculated subcutaneously.

These calves were about eleven months old at the time of the test inoculations, and were considerably older than the controls.

Calf 923 died in 36 days; the lungs were extensively hepatized and closely beset with grey nodules with caseous centres; the thoracic glands were enlarged and infiltrated with tubercles; the kidneys showed sparsely scattered grey foci, and the liver, suprarenal bodies, and a few lymphatic glands contained a few small tubercles.

Calf 925 was killed 90 days after the last inoculation, and showed one tubercle in a mediastinal gland and one in the spleen.

Of the two controls belonging to this set, one, No. 476, died in 57 days of general progressive tuberculosis; the other, No. 474, was killed 92 days after inoculation, and showed general progressive tuberculosis of moderate severity.

All the animals in this set were older at the time of the test inoculation than those in the first set.

* These preliminary vaccinations were done by Dr. Cobbett.

† See Appendix to 2nd Interim Report, Vol. I and Vol. II.

GENERAL SUMMARY.

(See Tabular Summary, pages 268-271.)

Controls.—Of the four control calves inoculated subcutaneously with bovine tubercle bacilli, three died in from 44 to 76 days of severe general tuberculosis; the fourth was killed after 92 days, and showed general progressive tuberculosis.

Vaccinated Animals.—Seven of the twelve vaccinated animals were killed in good health 90 to 95 days after the resistance-test inoculations, and showed for the most part slight and non-progressive lesions of tuberculosis in the internal organs. Two died after 53 and 87 days from some intercurrent disorder, and were also very slightly affected with tuberculosis.

Thus nine out of twelve animals had their resistance so far increased by the protective inoculations that 50 milligrammes of bovine tubercle bacilli were unable to set up in them progressive tuberculosis.

Of the three that remain, one (Calf 416) was killed when well after 89 days and showed general tuberculosis, less severe than that in any of the controls, but more extensive than in the seven just referred to, the lesions in the thorax being apparently progressive. The other two (Calves 923 and 1027) died in 36 and 46 days respectively of acute tuberculosis, differing in some important respects from that produced in the controls; although the lungs were severely affected there were only few tuberculous lesions visible in the other organs.

The test inoculation of virulent bovine culture in the vaccinated animals was followed in every case by the development within 24 hours of an oedematous swelling (except in calf 923), and a rise of temperature similar to that produced by tuberculin in a tuberculous animal, but of longer duration.

The character of the local lesion produced by the test inoculation in the inoculated animals which survived closely resembled that resulting, after an equal period, from the inoculation of slightly virulent tubercle bacilli in non-vaccinated animals.

These experiments clearly show that by the inoculation of large doses of living human tubercle bacilli, as well as by the inoculation of small doses of bovine tubercle bacilli, the resistance of a calf can be raised sufficiently to protect it against the inoculation of a dose of bovine tubercle bacilli which has been shown to be capable of setting up severe and fatal tuberculosis in a calf not so protected.

They show further that this degree of resistance is not always produced, and that calves which have been vaccinated once, and even twice, with slightly virulent human bacilli, may develop fatal tuberculosis when inoculated with virulent bovine bacilli.

A. STANLEY GRIFFITH.

F. GRIFFITH.

TABULAR SUMMARY

No. of Calf.	Age and Weight.	Protective Inoculations.		Duration of Immunization.	Resistance-test Inoculation.				Duration of Life after Resistance-test Inoculation.
		First.	Second.		Virus used.	Method of Inoculation.	Dose.	Date.	
1017	6 weeks. 42.63 kilos.	10 mg. of culture Virus H 8. "S.C." Intravenous. April 3rd, 1906.	—	63 days	B. XXVI.	Subcutaneous.	50 mg.	June 5th, 1906.	95 days. Killed when well.
1027	7 weeks. 42.63 kilos.	Do. do.	—	63 days	Do.	Do.	Do.	Do.	46 days. Died.
1039	9 weeks. 49.89 kilos.	Do. do.	1 mg. of culture Virus B. XXVI. Subcutaneous. June 5th, 1906. [63 days later.]	114 days	Do.	Do.	Do.	July 26th, 1906.	93 days. Killed when well.
1043	11 weeks. 56.24 kilos.	Do. do.	Do. do.	114 days	Do.	Do.	Do.	Do.	53 days. Died.
1023	5 weeks. 38.55 kilos.	50 mg. of culture Virus H 8. "S.C." Subcutaneous. April 3rd, 1906.	—	63 days	Do.	Do.	Do.	June 5th, 1906.	92 days. Killed when well.
1025	4 weeks. 48.05 kilos.	Do. do.	—	63 days	Do.	Do.	Do.	Do.	91 days. Killed when well.
1033	8 weeks. 45.80 kilos.	Do. do.	50 mg. of culture Virus H 56. "F.T." Intravenous. May 28th, 1906. [55 days later.]	114 days	Do.	Do.	Do.	July 26th, 1906.	90 days. Killed when well.
1035	12 weeks. 57.15 kilos.	Do. do.	Do. do.	114 days	Do.	Do.	Do.	Do.	91 days. Killed when well.
923	13 weeks. 61.22 kilos	10 mg. of culture Virus H 54. "C.W." Subcutaneous. October 4th, 1905.	50 mg. of culture Virus H 8. "S.C." Subcutaneous. April 3rd, 1906. [181 days later.]	244 days	Do.	Do.	Do.	June 5th, 1906.	36 days. Died.

OF THE EXPERIMENTS.

Result.

At the site of the resistance-test inoculation there was a fibrous walled cyst containing caseo-purulent masses and serous fluid. The adjacent prescapular gland was closely filled with gritty caseous nodules in a translucent matrix. Two cervical glands were similar; a third was caseous and softened throughout. In the lungs there were sparsely scattered translucent foci with calcareous centres; three small caseous gritty tubercles were also seen. The liver contained a few sparsely scattered grey foci. An omental gland showed opaque gritty foci.

At the site of the resistance-test inoculation there was a firm tumour, composed of dense gritty caseo-necrotic substance and thickened and infiltrated skin. The prescapular gland was enlarged and almost entirely caseated. Several cervical glands were more or less advanced in caseation; a prepectoral gland was beset with caseous foci. The lungs were extensively consolidated and beset with nodules up to a hempseed in size. The thoracic glands were enlarged, their cortex firm, grey, and mottled with yellow foci. There were numerous tubercles on the pleura and a few in the omentum, and sparsely scattered tubercles in the liver and a few in the kidneys. Many of the abdominal lymphatic glands contained each one or more tubercles or tuberculous patches. Tubercles were seen in the iris of both eyes.

At the site of the second protective inoculation there was a small fibro-caseo-calcareous mass and a few similar nodules. The cortex of the adjacent prescapular gland was beset with calcareous grains. At the site of the resistance-test inoculation there was a non-infiltrating caseous tumour, softened in the centre. The right prescapular gland showed caseous gritty streaks and foci in the cortex. Two cervical glands on this side contained tubercles. In the lungs four small tubercles were seen. The mediastinal glands contained an occasional focus. In the liver there was a single caseo-calcareous nodule (3 m.m.).

At the site of the second protective inoculation there was an aggregation of softened caseous nodules. About half the cortex of the left prescapular gland (? slightly enlarged) was beset with caseous gritty tubercles. At the site of the resistance-test inoculation there was an elongated fibro-caseous tumour, cystic in the upper part. The adjacent prescapular gland, slightly enlarged, contained a gritty caseating mass, and caseous streaks and foci. In the lungs there were a dozen yellow caseous nodules about the size of hemp seeds. The thoracic glands were normal. A dry cheesy nodule with a thin fibrous wall was seen in the liver. Other organs and glands were normal.

At the site of the protective inoculation there was a fibrous-walled cyst with caseo-purulent contents. In the right prescapular gland some caseo-calcareous tubercles were seen. At the site of the resistance-test inoculation there was an ulcerated tumour, composed of fibrous tissue with a zone of caseo-calcareous tubercles surrounding a central cavity which communicated with the ulcer by a sinus. The left prescapular gland contained two groups of caseo-calcareous tubercles. The lungs contained sparsely scattered tubercles, translucent, with gritty foci at the centre. All the thoracic glands contained one or more small tuberculous foci.

At the site of the protective inoculation there was a flattened fibro-caseo-calcareous tumour, ulcerated, and containing a central cavity. The prescapular gland contained numerous caseous tubercles in its cortex. At the site of the resistance-test inoculation there was a tumour slightly infiltrating the skin and muscle, composed of fibro-caseous gritty tissue, and ulcerated on the surface. The left prescapular gland was largely composed of similar tissue. Sparsely scattered throughout the lungs were translucent nodules with caseous or caseo-calcareous centres, up to a pea in size. Most of the thoracic glands contained one or more caseous or caseo-calcareous tubercles. One mesenteric and one colic gland, and a Peyer's patch showed each a single caseo-calcareous tubercle. The abdominal organs were normal.

At the site of the first protective inoculation there was a fibrous-walled cyst containing caseo-pus. In the adjacent prescapular gland there were a few caseo-calcareous tubercles and minute caseous foci. At the site of the resistance-test inoculation a tumour of similar character was seen. The left prescapular gland contained a single caseous nodule and some minute caseous foci. The lungs showed about a dozen small grey nodules with minute caseous centres, and about half a dozen small tubercles. Other organs and glands were normal.

At the site of the first protective inoculation there was a cyst containing caseo-purulent slightly gritty substance. At the site of the resistance-test inoculation a cystic tumour of similar character was seen. The adjacent prescapular glands (one slightly enlarged) contained two or three small caseo-calcareous patches and a few caseous foci. The lungs contained scattered nodules, the majority about 1 c.m. in diameter, containing a gritty caseous network or caseous foci. All the thoracic glands showed discrete caseous foci in the cortex. In the spleen there were three tubercles, translucent with gritty caseous centres. The liver showed a single yellow nodule (no T.B. found). Other organs and glands were normal.

At the site of the first protective inoculation there was a small fibro-calcareous lesion. Adjacent to it, at the site of the second, there was a fibrous-walled cyst, with caseo-purulent contents. The prescapular gland on this side showed calcareous nodules. At the site of the resistance-test inoculation there was a soft breaking-down caseous tumour (6 × 5.5 × 2.5 c.m.). The adjacent prescapular gland was enlarged and caseating. The left prepectoral and three left cervical glands contained caseous tubercles or nodules. The lungs were extensively consolidated and beset with grey nodules, slightly caseous in the centre. The thoracic glands were enlarged and infiltrated with tubercles. The liver and kidneys contained sparsely scattered minute tubercles. The spleen was normal. Each suprarenal contained a few tubercles. The portal, iliac, and right precrucial glands each contained one or more tubercles.

TABULAR SUMMARY

No. of Calf.	Age and Weight.	Protective Inoculations.		Duration of Immunization.	Resistance-test Inoculation.				Duration of Life after Resistance-test Inoculation.
		First.	Second.		Virus used.	Method of Inoculation.	Dose.	Date.	
925	13 weeks. 62.13 kilos.	10 mg. of culture Virus H. 54. "C.W." Subcutaneous. October 4th, 1905.	40 mg. of culture Virus H. 8. "S.C." Subcutaneous. April 3rd, 1906. [181 days later.]	244 days	B. XXVI.	Subcutaneous.	50 mg.	June 5th, 1906.	90 days. Killed when well.
414	5 weeks. 35.88 kilos.	0.001 mg. of culture Virus B. XXVI. Subcutaneous. June 5th, 1906.	—	51 days	Do.	Do.	Do.	July 26th, 1906.	87 days. Died.
416	5 weeks. 40.36 kilos.	Do. do.	—	51 days	Do.	Do.	Do.	Do.	89 days. Killed when well.
418	4 weeks. 29.03 kilos.	None.			B. XXVI.	Subcutaneous.	50 mg.	June 5th, 1906.	76 days. Died.
422	4 weeks. 34.00 kilos.				Do.	Do.	Do.	Do.	44 days. Died.
474	17 weeks. 73.93 kilos.				Do.	Do.	Do.	July 26th, 1906.	92 days. Killed when well.
476	19 weeks. 80.73 kilos.				Do.	Do.	Do.	Do.	57 days. Died.

Result.

At the site of the first protective inoculation there was a lesion composed of tough scar tissue with a few calcareous foci in the deeper part. Adjacent to it, at the site of the second, there was a fibrous walled cyst filled with caseo-pus. The right prescapular gland contained one pea-sized calcareous nodule only. At the site of the resistance-test inoculation there was a fibrous-walled tumour with caseo-purulent contents. The left prescapular gland contained two soft caseous nodules and many minute opaque gritty foci. No tubercles were seen in the lungs. One mediastinal gland contained a caseo-calcareous tubercle. In the spleen a single grey nodule with a minute calcareous centre was seen.

The tumour at the site of the protective inoculation was small, firm, and caseo-calcareous. The adjacent prescapular gland was small but extensively caseo-calcareous. The tumour resulting from the resistance test was a cyst filled with caseo-pus. In the adjacent prescapular gland there were numerous caseous gritty tubercles. The lungs were congested but contained no tubercles. Three of the thoracic glands showed one or more caseo-calcareous tubercles. In the spleen there were three tubercles consisting of softened gritty caseous substance in a translucent capsule.

No lesion could be found at the site of the protective inoculation. In the adjacent prescapular gland several pea sized collections of caseo-calcareous tubercles were seen, as well as a few small foci. The prepectoral gland was partly caseo-calcareous. At the site of the resistance-test inoculation there was a fibrous-walled cyst filled with caseo-pus. The adjacent prescapular gland contained small scattered caseous tubercles. The lungs were somewhat voluminous, and showed on the surface and on section numerous congested patches, the majority small, many with caseous foci; the right anterior lobe was consolidated throughout. The thoracic glands were enlarged, firm, and beset with caseo-calcareous nodules. In the spleen a single nodule was found, caseous and gritty, with a translucent margin. In the liver there were two tubercles of similar character. In the cortex of each kidney an occasional grey tubercle was seen. There were a few small caseous gritty tubercles in the portal, renal, and lumbar glands. A precrural and a parotid gland each contained a single tubercle.

General Tuberculosis.

General Tuberculosis.

General progressive Tuberculosis, moderately severe.

General Tuberculosis.

DETAILS OF THE EXPERIMENTS AND FULL POST-MORTEM NOTES OF THE CALVES INOCULATED.

CALF 1017.

Protective Inoculation—April 3, 1906; Intravenous inoculation into the right jugular vein of 10 milligrammes of culture derived from Virus H 8. "S.C." (Mesenteric glands).

Resistance-test Inoculation—June 5, 1906. [63 days after protective inoculation.] Subcutaneous inoculation on the left side of the neck of 50 mg. of culture derived from Virus B XXVI. (Bronchial gland).

Weight at beginning of Experiment—3 qrs. 10 lbs. [Age about 6 weeks.]

Killed when well—September 8, 1906. [158 days after the protective inoculation, and 95 days after the resistance-test inoculation.]

Clinical Notes.

Protective Inoculation.—The temperature rose to 40.0° C. fifteen days after the intravenous inoculation, and remained high for three weeks. After this it was approximately normal. Except for slight constitutional disturbance accompanying the rise of temperature, the calf remained well.

Resistance-test Inoculation.—Six hours after the inoculation the temperature rose to 40.0° C. It remained high for 9 hours, and then slowly fell, becoming normal on the fourth day (*see* chart). The temperature afterwards remained normal.

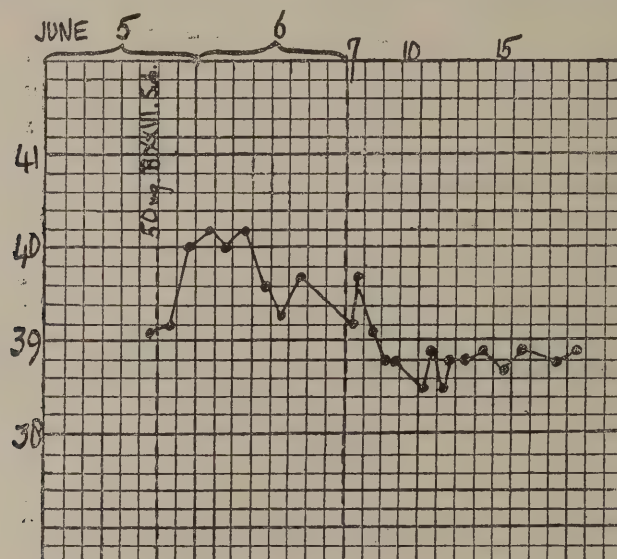
Twenty-four hours after, a tender ill-defined thickening could be felt under the skin, which measured 3 in. by 2 in.; the adjacent prescapular gland was slightly enlarged.

Four days after inoculation the flat subcutaneous thickening measured 4 in. by 2½ in.; on the 14th day the tumour was more prominent and measured 3 in. by 2 in. by about ¾ in. thick; the prescapular gland was about 2½ in. in length.

Two months after the inoculation the tumour was prominent and cystic, measuring 4 in. by 3 in.; the gland was a little over 3 in. in length. On September 8th, 95 days after inoculation, the calf was killed when in good health.

Temperature.

The chart gives the temperature for fourteen days following the resistance-test inoculation.



Each vertical division of the chart under the brackets represents an interval of three hours; elsewhere in the chart each division represents one day.

Weights.

		cwt.	qrs.	lbs.
April 3, 1906	...	0	3	10
June 25, 1906	...	1	0	12
September 8, 1906	...	1	2	4

The calf gained weight steadily during the experiment—2 qrs. 22 lbs. in five months (average rate of gain per week : 3.5 lbs).

POST-MORTEM EXAMINATION.

Condition.—Good.

Resistance-test inoculation.—On the left side of the neck in the subcutaneous tissues there was a rounded

projecting tumour measuring 4 in. by 3½ in. by 2½ in. and weighing with skin and muscle 10 ozs. On section it consisted of a fibrous walled cyst with fibrous trabeculae on the inner walls and was filled with large and small masses of curdy caseo-purulent substance in an almost clear serous fluid.

Left Prescapular Gland.—The left prescapular gland, measuring 3½ in. by 2½ in. by 1½ in. weighed 5 ozs. On section it was closely filled with gritty caseous nodules embedded in a firm translucent matrix. At one side there was a small cavity filled with soft caseo-pus.

Left Prepectoral Glands.—Normal.

Left Axillary Gland.—Normal.

Left Cervical Glands.—A left mid-cervical gland was enlarged and closely filled with caseo-calcareous

nodules with translucent fibroid margins: a second gland contained a caseous focus. A left inferior cervical gland, the size of a marble, was tense, and on section was filled with soft yellow caseous substance: a second gland showed discrete caseous nodules. Left superior cervical gland, normal.

Right Prescapular, Prepectoral, Axillary, and Cervical Glands were normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were crepitant without trace of congestion or collapse. They showed mainly just beneath the pleura sparsely scattered translucent foci with calcareous centres, and also beneath the pleura three tubercles rather larger than a millet-seed with soft caseous gritty centres.

Bronchial and Mediastinal Glands.—Normal.

Heart and Pericardium.—Normal.

Abdomen.

Omentum.—In the omentum there was a small gland 4 mm. in diameter containing opaque gritty foci.

Peritoneum.—From the anterior abdominal wall to the stomach there was a long fibrous adhesion.

Intestines.—Normal.

Gastric, Mesenteric, and Colic Glands.—Normal.

Spleen.—Normal.

Liver.—The liver showed a few sparsely scattered minute grey foci not appreciably gritty.

Portal Glands.—The portal glands contained a few congested foci, otherwise normal.

Gall-bladder.—Normal.

Kidneys and Suprarenal Bodies.—Normal.

Renal, Lumbar, and Iliac Glands.—Normal.

Tongue, Larynx, Pharynx, and Tonsils.—Normal.

Special Glands.

The Coeliac, Precrural, Supra-mammary, Gluteal, Popliteal, Ischiatic, Submaxillary, Parotid, and Retro-pharyngeal Glands were normal.

Microscopical examinations.

(Smear preparations):—

Focus from Liver.—No tubercle bacilli.

Focus from Lung (a).—No tubercle bacilli.

Focus from Lung (b).—A few tubercle bacilli.

CALF 1027.

Protective Inoculation—April 3, 1906; intravenous inoculation into the right jugular vein of 10 milligrammes of culture derived from Virus H 8. "S.C." (Mesenteric glands).

Resistance-test Inoculation—June 5, 1906. [63 days after protective inoculation.] Subcutaneous inoculation on the left side of the neck of 50 mg. of culture derived from Virus B. XXVI. (Bronchial glands).

Weight at beginning of Experiment—3 qrs. 10 lbs. [Age about 6 weeks.]

Died—July 21, 1906. [109 days after the protective inoculation, and 46 days after the resistance-test inoculation.]

Clinical Notes.

Protective Inoculation.—The temperature rose to 40.7° C. on the 18th day, and remained high for nearly three weeks. On the 37th day it fell to 38.8° C., and was very irregular during the following three weeks, the range of variation being 37.7° C.–40.0° C.

The calf suffered from the usual constitutional disturbance during the period of high temperature, but was at no time seriously ill. It was quite well at the time of the resistance-test inoculation.

Resistance-test Inoculation.—Three hours after inoculation the temperature was 39.8° C., 45 hours later it reached 40.7° C., and then slowly fell (see chart).

At the site of inoculation a tender oedematous swelling developed which at the end of 24 hours measured 3½ in. in diameter.

On the fourth day the swelling was flatter (and ? firmer) and measured 3 in. by 2½ in. in superficial area.

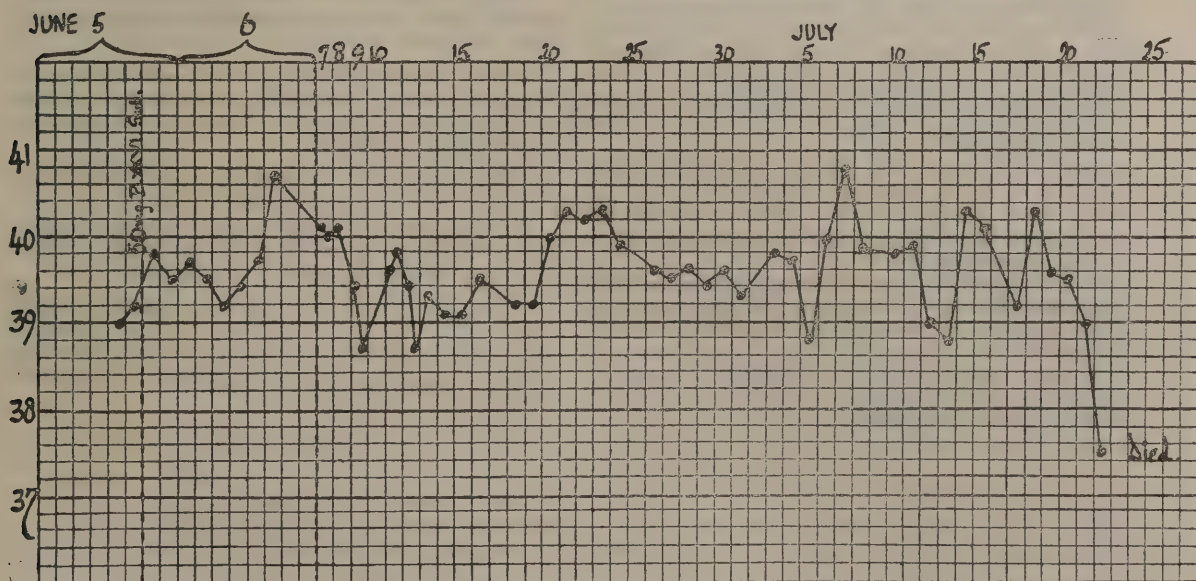
On the 14th day it measured 4 in. by 3½ in., and showed a patch of reddened skin with a dry adherent scab in the centre. The respirations were distinctly increased in frequency, and there was an occasional cough.

On the 21st day the local conditions were unchanged, the respirations were still quicker than normal, and the temperature high (39.6° C.).

On the 31st day the animal was ill; its coat was rough, and it was thinner, though not emaciated, and suffered from photophobia; the temperature was high (40.0 C.). A fortnight later the calf died.

Temperature.

The temperature of the animal subsequent to the resistance-test inoculation is given below.



Each vertical division of the chart under the brackets represents an interval of three hours; elsewhere in the chart each division represents one day.

Weights.

			qrs.	lbs.
April 3, 1906	...	...	3	10
June 25, 1906	...	...	3	4
July 21, 1906	...	...	2	25
Total loss of weight during the experiment—13 lbs.				

POST-MORTEM EXAMINATION.

Resistance-test Inoculation.—Local Lesion.—On the left side of the neck there was a firm flat tumour measuring $4\frac{1}{2}$ in. by 3 in. by not quite 1 in. in greatest thickness; on section it was composed of two layers, an external one of greatly thickened skin, showing a yellow caseous infiltration, and a subcutaneous one of very dense pinkish yellow caseo-necrotic substance, containing sparsely scattered yellow calcareous foci, adherent to and slightly infiltrating the muscles.

Left Prescapular Gland.—The left prescapular gland weighed 5 ozs. and measured $3\frac{1}{2}$ in. by $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in.; on section the whole of the cortex, with the exception of a small patch which contained discrete caseous nodules, was composed of dense yellow caseated tissue containing sparsely scattered calcareous foci.

Right Prescapular Gland.—Normal.

Prepectoral Glands.—On the left side the spherical prepectoral gland, 1 cm. in diameter, was composed of grey translucent tissue beset with yellow caseous foci; two other glands on this side were enlarged and oedematous but not otherwise abnormal.

The glands on the right side were normal.

Cervical Glands.—On the left side one of the lower cervical glands was enlarged, $1\frac{1}{4}$ in. in length, indurated and extensively caseated (not so advanced as the prescapular). A gland in the middle of the neck showed caseation around one margin of the cortex. The upper cervical gland showed part of the cortex firm and grey and speckled with yellow caseous foci.

On the right side the cervical glands were normal.

Thorax.

There was a slight excess of fluid in the pleural cavities.

Lungs.—The cephalic, right middle, and antero-ventral portions of the caudal lobes were firm, dark red, and quite airless; the posterior and dorsal portions of the caudal lobes were still air-containing and showed small angular red patches of consolidation.

The lung parenchyma contained moderately numerous firm nodules, ranging in size from a pin's head to that of a hemp seed. The smaller nodules were greyish, with opaque yellowish white centres; the larger ones were yellow, and showed in the centre one or two small calcareous foci. The nodules were not so numerous in the right cephalic and right middle lobes as in the other; on the surface, however, of the right cephalic lobe there was an eruption of yellow caseous tubercles, up to a millet seed in size, and two larger nodules, loosely attached. In the other consolidated lobes the subpleural nodules projected slightly from the surface, and some were "mushroomed."

Thoracic Glands.—The caudal mediastinal gland measured 4 in. in length and was nodular on the surface; on section the cortex was composed of firm grey translucent tissue, mottled with irregular yellow foci and patches of necrosis.

The left bronchial gland was enlarged, and showed the greater part of the margin of the cortex composed of firm grey tissue containing irregular yellow foci; the medulla was very soft.

The right bronchial gland was slightly enlarged and oedematous, and contained sparsely scattered caseous foci up to 1 mm. in diameter.

Other dorsal mediastinal glands were slightly enlarged, and showed in the cortex more or less discrete tubercles with opaque centres.

The ventral mediastinal glands contained a few opaque white foci.

Pleura.—The fringes along the margins of several of the ribs were congested and slightly hypertrophied, and contained clusters of tubercles, varying in size up to that of a hemp seed; the larger ones were opaque and yellow in the centre.

On the pleura covering the pericardium there were numerous firm yellow caseous nodules, occurring chiefly in clusters, the largest the size of a hemp seed; there were several similar clusters of nodules, as well as single ones, on the pleural surface of the diaphragm and the caval fold of pleura.

Abdomen.

Omentum.—The omentum contained three or four tubercles, the largest the size of a millet seed, one deeply congested, none caseous.

Spleen.—The spleen was small, weight 4 ozs.; the capsule was wrinkled and the trabeculae, in places, greatly thickened; no tubercles were seen.

Liver.—The liver showed on the surface under the capsule sparsely scattered grey tubercles, with yellow centres, ranging in size from a pin's head to a little larger than a millet seed; a few of these tubercles were slightly raised and had overhanging margins. On section similar tubercles were sparsely disseminated throughout the substance; some of the larger ones were slightly gritty.

Portal Glands.—The portal glands were not apparently enlarged; each contained a few minute yellow foci and two or three miliary tubercles, opaque and yellow in the centre.

Kidneys.—The left kidney showed in the cortex three or four grey tubercles, the largest 1 mm. in diameter, and one larger tubercle (1.5 mm.) with an opaque yellow centre.

The right kidney contained one yellow tubercle, about twice the size of a millet seed.

Suprarenals.—Normal.

Tongue, Tonsils, Pharynx, Larynx, and Trachea.—Normal.

Intestines.—Normal.

Gastric Glands.—One gastric gland was slightly enlarged and showed the cortex firm and grey and beset with yellow caseous points. Another gastric gland contained a few caseous foci.

Mesenteric Glands.—One contained a hemp seed sized nodule with a yellow centre.

Ileo-Colic and Colic Glands.—One ileo-colic gland showed a small grey patch containing opaque points. Colic glands normal.

Lumbar Glands.—One on the left side contained a hemp seed sized nodule with a yellow gritty centre and grey translucent margin; another contained three opaque miliary tubercles.

Renal Gland.—A renal gland on the left side showed two or three opaque yellow foci.

Various Lymphatic Glands.—The coeliac, pudic, precrucal, iliac, ilio-sacral, popliteal, gluteal, ischiatic, axillary, and parotid glands were normal.

Eyes.—In the iris of each eye, arranged chiefly around the periphery, were numerous soft brownish foci which microscopically contained numerous tubercle bacilli; the aqueous humour was cloudy and the lens slightly opaque.

Testicles.—Normal.

CALF 1039.

First Protective Inoculation—April 3, 1906; intravenous inoculation into the right jugular vein of 10 milligrammes of culture derived from Virus H 8, "S.C." (Mesenteric glands).

Second Protective Inoculation—June 5, 1906. [63 days after 1st protective inoculation.] Subcutaneous inoculation on the left side of the neck of 1 mg. of culture derived from Virus B. XXVI. (Bronchial glands.)

Resistance test Inoculation—July 26, 1906. [51 days after 2nd protective inoculation.] Subcutaneous inoculation of 50 mg. of culture derived from the same source, Virus B. XXVI.

Weight at beginning of Experiment—3 qrs. 26 lbs. [Age about 9 weeks.]

Killed when well—October 27, 1906. [207 days after the first protective inoculation and 93 days after the resistance-test inoculation.]

Clinical Notes.

First Protective Inoculation.—The temperature rose on the 9th day, reached 40.7° C. on the 15th day, and and remained high for two weeks; after this it slowly returned to the normal. The calf suffered from the usual constitutional disturbances during the period of high temperature, but was at no time seriously ill. It was quite well at the time of the second protective inoculation.

Second Protective Inoculation.—Twenty-one hours after inoculation the temperature rose to 39.9° C. and nineteen hours later it reached 40.6° C. After this it quickly fell to normal (see chart).

Twenty-four hours after inoculation a slight local thickening could be felt, somewhat deeply situated. The prescapular gland was appreciably enlarged.

On the 14th day there was only a slight thickening

at the seat of inoculation, and the prescapular gland was normal in size.

The calf had remained well.

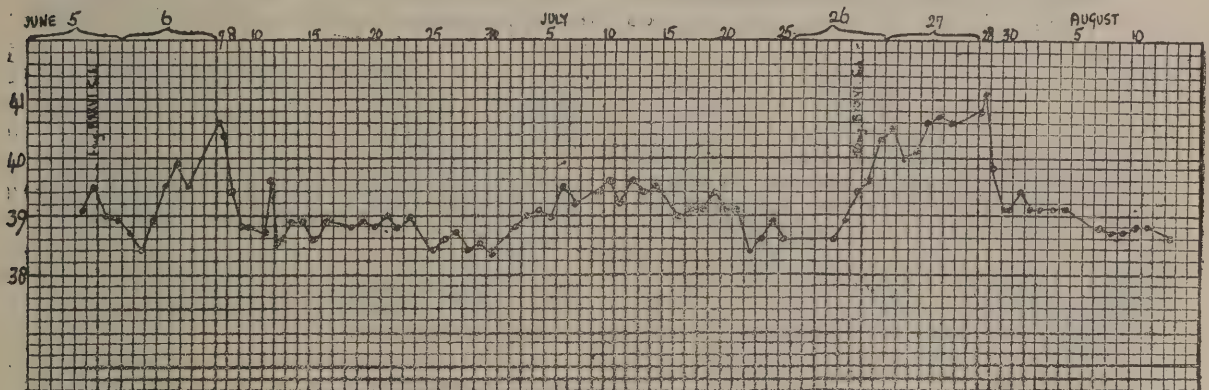
Resistance-test Inoculation.—Six hours after inoculation the temperature rose to 40.3° C. It remained high for 42 hours, reaching a maximum of 41.1° C. After this it rapidly fell to normal (see chart). Twenty-four hours after inoculation a tender slightly raised thickening, 3 in. in diameter, could be felt; the adjacent prescapular gland was slightly enlarged.

Four weeks after inoculation there was a slightly raised irregular firm tumour on the right side, measuring 2½ in. by 1¾ in. This afterwards softened, and decreased in size; seven weeks after inoculation it measured 2 in. by 1¼ in.

Five weeks later the calf was killed when in good health. The temperature had been normal subsequent to the initial rise recorded above.

Temperature.

The temperatures of the animal from June 5 (date of second protective inoculation) to August 13 (18 days after the resistance-test inoculation) are given below. The temperature was normal from August 13 until the calf was killed.



Each vertical division of the chart under the brackets represents an interval of three hours; elsewhere in the chart each division represents one day

Weights.

	cwt.	qrs.	lbs.	
April 3, 1906	...	0	3	26 First protective inoculation.
June 25, 1906	...	1	1	7
July 26, 1906	...	1	2	1 Resistance-test inoculation.
October 27, 1906	...	1	3	12 Killed.

The calf gained weight steadily during the whole period of the experiment.

Total gain of weight.—3 qrs. 14 lbs.

Average rate of gain per week.—3.3 lbs.

POST MORTEM EXAMINATION.

Condition.—Good.

Second Protective Inoculation.—On the left side of neck in the subcutaneous tissue there was a flattened thickening 2 cm. by 1 cm., which on section consisted of caseo-calcareous substance in a grey fibroid capsule. There were in the tissue around about twelve similar but smaller nodules, ranging in size from a millet seed to a wheat grain.

Left Prescapular Gland.—The left prescapular gland measured 2¾ in. by 1½ in. by ½ in. On section the cortex was beset with irregular calcareous grains confined mainly to the periphery of the gland.

Left Prepectoral, Axillary and Cervical Glands.—Normal.

Resistance-Test Inoculation.—On the right side of the neck in the subcutaneous tissues there was a slightly prominent oval tumour 2 in. by 1½ in. by ¾ in. The tumour infiltrated neither skin nor muscle, and was filled with caseous substance soft in the centre but adherent around the wall.

Right Prescapular Gland.—The right prescapular gland was a little enlarged, measuring 3¼ in. by 1½ in. by ½ in. It was firm, and on section the superficial part of the cortex was beset with small irregular gritty caseous streaks and foci.

Right Prepectoral and Axillary Glands.—Normal.

Right Cervical Glands.—The right superior cervical gland showed at one extremity a small collection of irregular caseous foci. A gland in the middle of the neck contained a few scattered caseo-calcareous tubercles up to the size of rape seed. Other right cervical glands were normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were pink and crepitant. The right anterior lobe showed on the surface beneath the pleura one translucent milary tubercle with a calcareous centre. Beneath the pleura of the right posterior lobe there were two tubercles, the larger the size of a hemp seed. The left anterior lobe contained one translucent milary tubercle. The rest of the lung was normal.

Thoracic Glands.—The bronchial glands were normal.

The mediastinal glands were normal in size; each one showed an occasional irregular opaque focus, some of which were appreciably gritty.

Heart and Pericardium.—Normal.

Abdomen.

Omentum.—The omentum contained a single flat grey nodule 3 mm. in diameter with a caseo-calcareous centre.

Peritoneum.—Normal.

Intestines.—Normal.

Gastric, Mesenteric, and Colic Glands.—Normal.

Spleen.—The spleen, weighing 6 oz., was normal.

Liver.—Just beneath the capsule of the liver on the convex surface there was a caseo-calcareous nodule 3 mm. in diameter, which shelled easily out of a thin translucent capsule. The rest of the liver was normal except for a grey point in the substance.

Portal Glands and Gall Bladder.—Normal.

Kidneys, Suprarenal Bodies, and Renal Lymphatic Glands.—Normal.

Coeliac, Lumbar, and Iliac Glands.—Normal.

Tongue, Pharynx, Larynx, and Tonsils.—Normal.

Special Glands.

Precrural, Gluteal, Popliteal, Ischiatic, Submaxillary, Parotid, and Retro-pharyngeal Glands.—Normal.

Microscopical Examinations.

(Smear preparations):—

Nodule from Liver.—Three tubercle bacilli seen.

Focus from Mediastinal Gland.—No tubercle bacilli.

Calf 1043.

First Protective Inoculation—April 3, 1906; intravenous inoculation into the right jugular vein of 10 milligrammes of culture derived from Virus H. 8 "S. C." (Mesenteric glands).

Second Protective Inoculation—June 5, 1906. [63 days after first protective inoculation.] Subcutaneous inoculation on the left side of the neck of 1 mg. of culture derived from Virus B. XXVI. (Bronchial glands).

Resistance-test Inoculation—July 26, 1906. [51 days after second protective inoculation.] Subcutaneous inoculation on the right side of the neck of 50 mg. of culture derived from same source, Virus B. XXVI.

Weight at beginning of Experiment—1 cwt. 0 qr. 12 lbs. [Age about 12 weeks.]

Died—September 17, 1906. [167 days after the first protective inoculation, and 53 days after the resistance-test inoculation.]

Clinical Notes.

First Protective Inoculation.—The temperature rose to 40.1° C. fifteen days after the intravenous inoculation; it remained high for a week only, and was afterwards approximately normal. Except for a slight constitutional disturbance accompanying the rise of temperature, the calf remained well.

Second Protective Inoculation.—Forty hours after the inoculation the temperature rose to 39.9° C.; it then rapidly fell to normal (see Chart)

Twenty-four hours after inoculation there was a slightly raised tender oedematous swelling 3½ in. in diameter; the adjacent prescapular gland was slightly enlarged.

On the 14th day there was a slight thickening only at the seat of inoculation, and the prescapular gland was about normal in size. The calf was in good health.

The temperature, subsequent to the initial rise recorded above was irregular for ten days, and then remained approximately normal until the resistance-test inoculation.

Resistance-test Inoculation.—Nine hours after in-

oculation the temperature rose to 39.9° C. It continued to rise, reaching 41.0° C. in forty-two hours. After this it fell; 39° C. was recorded on the fifth day after inoculation (see Chart).

Twenty-four hours after the inoculation, a tender ill-defined thickening could be felt, measuring 3 in. by 2 in., and the adjacent prescapular gland was slightly enlarged.

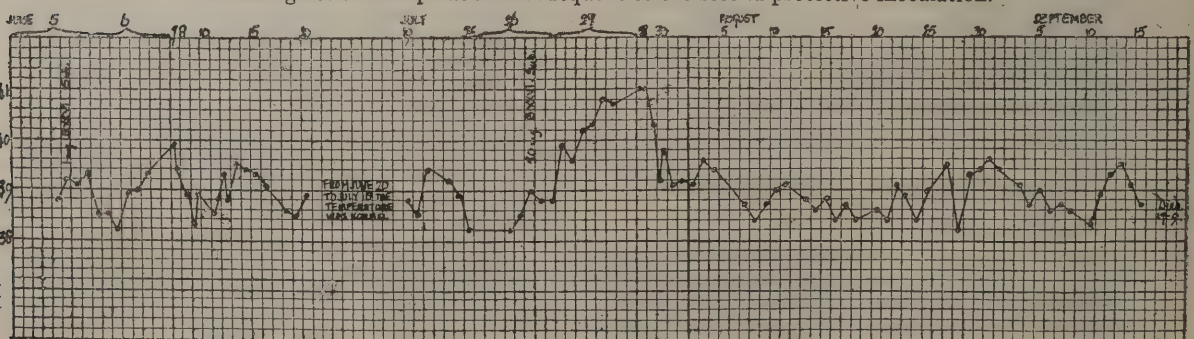
On the 13th day an elongated slightly raised thickening measuring 6 in. by 2½ in., could be felt at the seat of inoculation, and the prescapular gland was appreciably enlarged.

On the 28th day there was an elongated local tumour, measuring 6 in. by 2½ in., the upper part prominent and softened, the lower part thin and hard. The right prescapular gland was twice the size of the left. For three weeks the temperature had been approximately normal.

The animal subsequently became very thin and ill, and suffered from diarrhoea; it died 53 days after the resistance-test inoculation. During the last three weeks of life the temperature was irregular, but not high, the maximum being 39.6° C.

Temperature.

The chart gives the temperatures subsequent to the second protective inoculation.



Each vertical division of the chart under the brackets represents an interval of three hours; elsewhere in the chart each division represents one day.

Weights.

	cwt.	qrs.	lbs.	
April 3, 1906	...	1	0	12 First protective inoculation.
June 25, 1906	...	1	1	4
July 26, 1906	...	1	1	9 Resistance - test inoculation.
September 17, 1906	1	0	0	Died.

During the period covered by the two protective inoculations the calf gained in weight (25 lbs.). After the resistance test inoculation it lost weight considerably (1 qr. 9 lbs. in 53 days).

POST MORTEM EXAMINATION.

Second Protective Inoculation.—On the left side of the neck there was a flat patch, irregular in outline, measuring roughly $2\frac{1}{2}$ in. by $1\frac{1}{4}$ in. in area, which on section was composed of caseous nodules closely aggregated together, except around the margins of the mass, where they were more or less discrete; the nodules had thin fibrous walls and soft creamy caseous contents. The skin and muscles were adherent but not infiltrated.

Left Prescapular Gland.—The left prescapular gland measured nearly 2 in. in length, by a little over 1 in. in breadth, by $\frac{1}{2}$ in. in thickness. On section a little more than half the cortex was beset with caseous gritty tubercles here and there aggregated together to form irregular caseous areas.

Left Prepectoral Gland.—The rounded prepectoral gland on the left side, the size of a large pea, showed around the cortex yellow caseous gritty tubercles, in one part forming a confluent patch.

Left Cervical Glands.—A mid-cervical gland on the left side, slightly oedematous, contained several small caseous foci. Other cervical glands on this side were normal.

Resistance-test Inoculation.—On the right side of the neck there was an elongated tumour measuring $5\frac{1}{2}$ in. by 2 in., and $1\frac{1}{4}$ in. in greatest thickness; somewhat prominent soft and fluctuating in the upper two-thirds, firm and thinner in the lower one-third. On section the upper portion was a cyst, with turbid fluid contents, and dense fibro-caseous wall $\frac{3}{16}$ in. in greatest thickness, very irregular on its internal surface; the cavity was crossed by fibrous trabeculae. The lower portion of the tumour was composed of dense fibro-caseous tissue appreciably gritty from calcification.

Right Prescapular Gland.—The right prescapular gland measured $2\frac{1}{4}$ in. by $1\frac{1}{4}$ in. by $\frac{1}{2}$ in., and showed on longitudinal section about an inch of the cortex composed of dense caseating slightly gritty tissue;

the rest of the cortex, except at one extremity, which was normal in appearance, was beset with yellow foci and streaks of caseation, many just perceptibly gritty.

Right Prepectoral Gland.—The rounded prepectoral gland on the right side, the size of a large pea, showed on section a number of minute caseous points. Other prepectoral glands on this side were normal.

Right Cervical Glands.—An upper cervical gland on the right side showed at one extremity a group of caseous foci. A superior cervical gland also showed a group of caseous foci at one extremity. The rest were normal.

Axillary glands, left and right, normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were pinkish, crepitant, and collapsed normally. The left lung showed on the surface under the pleura about half-a-dozen yellow caseous nodules with grey margins, the largest rather larger than a hempseed. In the right lung there were about the same number of nodules, none larger than a millet seed. On section of the lung one tubercle was found in the left caudal lobe, none elsewhere.

Bronchial and Mediastinal Glands.—Normal.

Heart.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—The spleen was smaller than normal. The pulp was atrophied, the fibrous trabeculae being more conspicuous than normal.

Liver.—The liver was pale, and showed on the anterior surface under the capsule an irregular yellow nodule a little larger than a hempseed; on section the nodule had a thin fibrous wall and dry, cheesy, gritty contents. The liver was otherwise normal.

Portal Glands.—Normal.

Kidneys and suprarenal bodies.—Normal.

Coeliac, Lumbar, Ilio-Sacral, Iliac, Precural, and Pudic glands.—Normal.

Alimentary Tract.

Tongue, Pharynx, Palate, Tonsils, Larynx.—Normal.

Pharyngeal, Submaxillary, and Parotid Glands.—Normal.

Intestines.—Normal.

Mesenteric and Colic Glands.—Normal.

Testes.—Normal.

Eyes.—Normal.

CALF 1023.

Protective Inoculation.—April 3, 1906; Subcutaneous inoculation on the right side of the neck of 50 milligrammes of culture derived from Virus H. 8 "S. C." (Mesenteric glands).

Resistance-test Inoculation.—June 5, 1906. [63 days after protective inoculation.] Subcutaneous inoculation on the left side of the neck of 50 milligrammes of culture derived from Virus B, XXVI. (Bronchial glands).

Weight at beginning of Experiment.—3 qrs. 1 lb. (Age about 5 weeks.)

Killed when well.—September 6, 1906. [155 days after the protective inoculation, and 92 days after the resistance-test inoculation.]

Clinical Notes.

Protective Inoculation.—A small tumour of the usual non-infiltrating type developed at the seat of inoculation, and the adjacent prescapular gland became slightly enlarged.

The temperature was irregular during seven weeks, but at no time was it much above the normal, the highest temperature recorded being 39.6° C.

Two months after inoculation the local tumour was the size of a pigeon's egg, prominent and softened; extending downwards from it was a narrow elongated thickening 5 in. in length. The calf remained in good health.

Resistance-test inoculation.—Six hours after inoculation the temperature rose to 40.0° C., and reached a maximum of 40.7° C. 24 hours after inoculation.

After this it slowly fell, becoming normal on the 8th day (see Chart).

Twenty-four hours after inoculation an elongated oedematous swelling could be felt. The adjacent prescapular gland was not enlarged.

On the 4th day there was a small firm local swelling about $1\frac{1}{2}$ in. in diameter, with an oedematous band extending from it into the tissues of the neck. The prescapular gland was slightly enlarged.

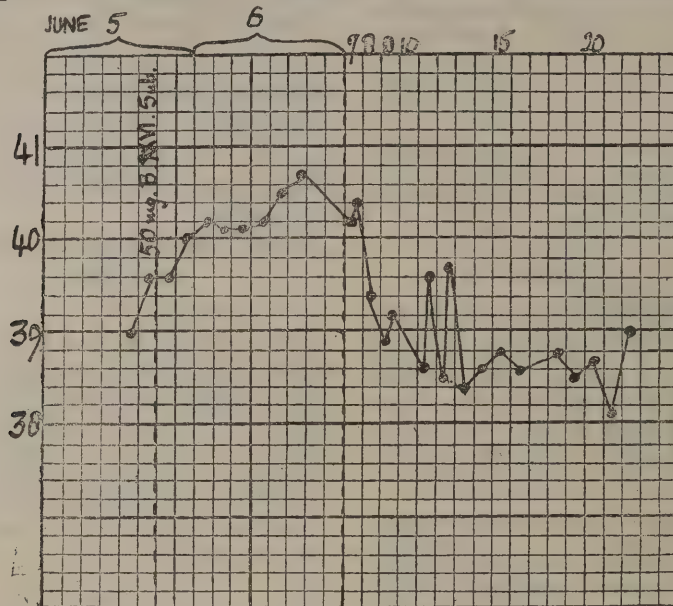
On the 21st day the swelling was oval, about the size of a bantam's egg; the gland was still slightly enlarged.

The swelling subsequently diminished in size; on the 64th day it was only $\frac{1}{2}$ in. in diameter.

The calf remained well; it was killed 92 days after the resistance-test inoculation. The temperature, subsequent to the initial rise recorded above, had remained approximately normal.

Temperature.

The chart gives the temperature for 17 days subsequent to the resistance-test inoculation.



Each vertical division of the chart under the brackets represents an interval of three hours; elsewhere in the chart each division represents one day.

Weights.

	cwt.	qrs.	lbs.	
April 3, 1906	...	0	3	1 Protective inoculation.

June 25, 1906	...	0	3	15
September 5, 1906		1	0	3 Killed.

The calf gained 30 lbs. in weight during the experiment; the average rate of gain per week was 1.4 lbs.

POST-MORTEM EXAMINATION.

Condition.—Good.

Protective Inoculation.—On the right side of the neck in the subcutaneous tissues there was an irregularly shaped tumour consisting of a rounded prominent portion about the size of a pigeon's egg connected with a deeper sausage-shaped swelling $2\frac{3}{4}$ in. in length. It was adherent to skin and muscle without infiltration. On section it consisted of a cyst with fibrous walls containing caseo-purulent slightly gritty substance; the inner wall was roughened by strands of fibrous tissue.

Right Prescapular gland.—The right prescapular gland measured 2 in. by $\frac{3}{4}$ in. by $\frac{1}{4}$ in. On section it contained two small patches of caseo-calcareous tubercles up to a millet seed in size and an occasional discrete tubercle.

The right Prepectoral and Axillary glands were normal.

Right Cervical glands.—The right superior cervical gland was normal. Of two small glands in the middle of the right side of the neck one contained a single tubercle, the other several caseous gritty tubercles up to a millet seed in size. In the right inferior cervical gland there were a few yellow calcareous grains.

Resistance-test Inoculation.—On the left side of the neck in the subcutaneous tissues there was a flattened roughly circular tumour $1\frac{1}{4}$ in. in diameter. In the skin over it there was an ulcer $\frac{1}{2}$ in. in length communicating with a small cavity in the tumour. The tumour consisted of fibrous tissue with caseo-calcareous tubercles just around the cavity.

Left Prescapular Gland.—The left prescapular gland measured $2\frac{1}{2}$ in. by $1\frac{1}{4}$ in. by $\frac{1}{2}$ in. On section it contained two small nodules at one extremity composed of collections of caseo-calcareous tubercles.

Left Prepectoral Glands.—The left round prepectoral gland showed caseo-calcareous tubercles around the cortex, collected into a small nodule at one part. Left reniform prepectoral gland normal.

Left Axillary Gland.—Normal.

Left Cervical Glands.—The left superior cervical gland had about half its substance replaced by caseo-calcareous tubercles. Two left middle cervical glands contained a few discrete caseo-calcareous tubercles the size of rape seed. An inferior cervical gland showed similar caseo-calcareous tubercles replacing a third of the gland.

Thorax.

Pleura.—Normal.

Lungs.—The lungs collapsed normally and were soft and crepitant. The left lung showed on the surface sparsely scattered translucent tubercles varying from 1 to 4 mm. in diameter, which contained in the centre either a single or several yellow gritty foci. On section of the lung a few could be seen in the substance, but the majority were superficial. The right lung showed similar scattered nodules.

Thoracic Glands.—In each of two left bronchial glands there was a single yellow gritty focus.

In the right supra-bronchial gland there were a few very minute opaque foci and a single caseous tubercle in the small gland at the root.

In the long mediastinal gland there were sparsely scattered tubercles, varying from an opaque focus up to a rape seed in size. There were a few minute opaque foci in the other mediastinal glands.

Heart, Pericardium and Diaphragm.—Normal.

Abdomen.

Peritoneum and Omentum.—Normal.

Stomach and Intestines.—Normal.

Gastric, Mesenteric, and Colic Glands.—Normal.

Spleen, Liver, Gall-bladder and Portal Glands.—Normal.

Kidneys, Suprarenal Bodies and Renal Glands.—Normal.

Lumbar and Iliac Glands.—Normal.

Tongue, Pharynx, Larynx, Tonsils and Trachea.—Normal.

Various Lymphatic Glands.

The Preaural, Pudic, Gluteal, Popliteal, Ischiatic, Submaxillary, Parotid and Retro-pharyngeal Glands were normal.

Microscopical Examination.

(Smear preparation):—

Tubercle from Mediastinal Gland.—No tubercle bacilli.

CALF 1025.

Protective Inoculation—April 3, 1906; subcutaneous inoculation on the right side of the neck of 50 milligrammes of culture derived from Virus H 8 "S.C." (Mesenteric glands).

Resistance-test Inoculation—June 5, 1906. [63 days after protective inoculation.] Subcutaneous inoculation on the left side of the neck of 50 milligrammes of culture derived from Virus B. XXV. (Bronchial glands).

Weight at beginning of Experiment—3 qrs. 22 lbs. [Age about 8 weeks.]

Killed when well—September 4, 1906. [154 days after the protective inoculation, and 91 days after the resistance-test inoculation.]

Clinical Notes.

Protective Inoculation.—A small tumour of the usual non-infiltrating type developed at the seat of inoculation, and the adjacent prescapular gland became slightly enlarged.

The calf remained well, and there was no rise of temperature following the inoculation.

Resistance-test Inoculation.—Six hours after inoculation the temperature rose to 40.1°C., and reached a maximum of 40.9°C. 42 hours later.

On the fourth day it had fallen to normal, 39.0°C. (See chart.)

Twenty-four hours after inoculation an elongated oedematous swelling could be felt extending into the tissues of the neck, 3 in. in length, firmer above than

below; the left prescapular gland was slightly enlarged.

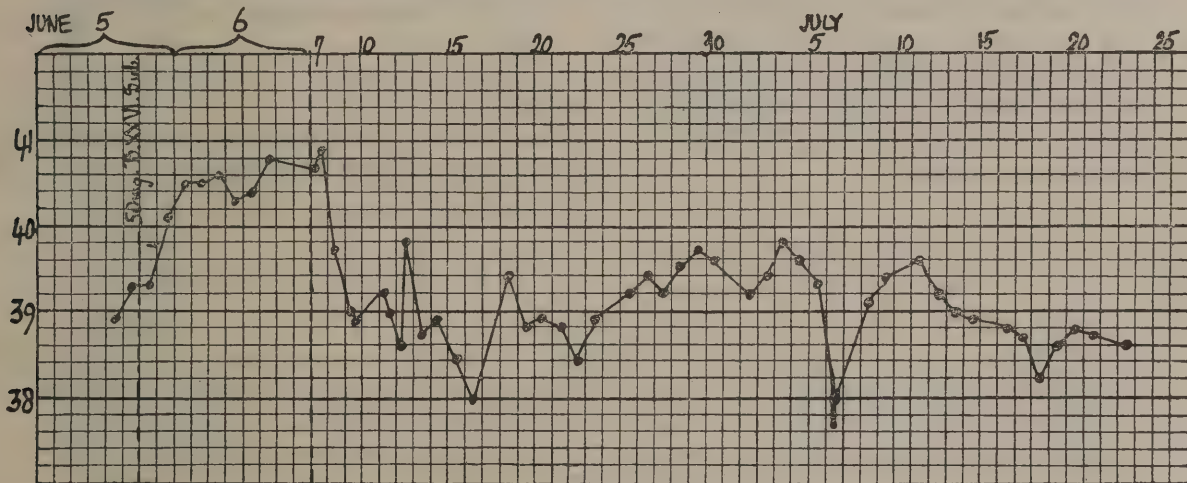
On the fourth day there was a flat subcutaneous thickening at the seat of inoculation, 4 by 3 in., slightly oedematous below. The prescapular gland was 2 in. in length.

On the 21st day the local thickening measured 4 by 2½ in., and the skin over it showed a dry ulcer. The calf was in good health; the temperature was, however, raised a little above normal, 39.4°C.

On the 64th day there was a slightly raised elongated swelling at the seat of inoculation, 6 in. by 3 in., with an irregular ulcer in the upper part 1½ in. in greatest length. The prescapular gland was enlarged, 3½ in. long. The calf was in good health, the temperature normal. During the rest of the experiment the local conditions and the general health of the animal remained unchanged, and on the 91st day after the resistance-test inoculation the calf was killed

Temperature.

The temperature of the calf for 48 days subsequent to the resistance-test inoculation is given below. From July 22 until the calf was killed the temperature was normal.



Each vertical division of the chart under the brackets represents an interval of three hours; elsewhere in the chart each division represents one day.

Weights.

	cwt.	qrs.	lbs.	
April 3, 1906	...	0	3 22	Protective inoculation.
June 25, 1906	...	1	1 7	
September 4, 1906	...	1	2 24	Killed.

The calf gained 3 qrs. 2 lbs. in weight during the experiment; the average rate of gain per week was therefore 4 lbs.

POST-MORTEM EXAMINATION.

Condition.—Good.

Protective Inoculation.—On the right side of the neck in the subcutaneous tissues there was a flattened tumour 1½ in. by ½ in. with a central constriction. On section one half contained a small cavity filled with caseo-pus, while the other half and the central constricted portion were composed of fibrous tissue containing scattered caseo-calcareous foci and a softened caseous nodule.

Right Prescapular Gland.—The right prescapular gland measured 2½ in. by 1 in. by ½ in. The greater part of the cortex, viewed from the outside, was closely filled with irregular caseous tubercles. On section these were softened and slightly gritty, and, with the exception of a pea-sized nodule in the deeper part, were confined to the periphery of the gland.

Right Prepectoral and Cervical Glands.—Normal.

Right Axillary Gland.—Normal.

Resistance-test Inoculation.—On the left side of the neck in the subcutaneous tissues there was a somewhat flattened, roughly pear-shaped tumour measuring 7 in. by 3 in. by 1½ in. and weighing with skin and muscle 12 ozs. In the skin there was an oval depressed ulcer 1½ in. by 1 in. with undermined edges. On section the tumour was composed of fibro-caseous, gritty tissue, adherent to both skin and muscle, and containing a central cavity the walls of which were partly lined by pinkish granulation tissue and partly honeycombed by translucent bands stretching across them. There was some infiltration of the skin round

the margins of the ulcer and slight extension into the muscle in the form of caseous foci.

Left Prescapular Gland.—The left prescapular gland weighed 4 ozs. and measured $4\frac{1}{2}$ in. by 2 in. by $1\frac{1}{2}$ in. On section the greater part of the gland was replaced by firm fibro-caseous gritty tissue with scattered hæmorrhagic foci. There was a small part of the medulla unaffected and part of the cortex with more or less discrete caseo-calcareous tubercles.

Left Prepectoral Glands.—The left round prepectoral was slightly enlarged. The left reniform prepectoral gland contained one minute caseous focus in which tubercle bacilli were demonstrated.

Left Axillary Gland.—Normal.

Left Cervical Glands.—The left superior cervical gland was enlarged and diffusely caseo-calcareous throughout.

Thorax.

Pleura.—Normal.

Lungs.—On the surface beneath the pleura of the left cephalic lobe there were seven translucent nodules up to 2.5 mm. in diameter with yellow caseo-calcareous centres. The left caudal lobe showed scattered nodules varying in size from a millet seed up to a pea; the smallest were translucent for the most part with calcareous centres, while the largest contained a fine caseous network, appreciably gritty.

On the surface of the right lung beneath the pleura there were scattered nodules similar to but more numerous than those on the left, varying from 5 to 8 mm. in diameter. Between the right anterior and middle lobes where the surfaces were in contact there were twelve loosely attached growths up to 8 mm. in diameter composed of translucent tissue with yellow caseating centres.

On section of both lungs there were similar nodules sparsely scattered throughout the substance.

Thoracic Glands.—The right supra-bronchial gland contained scattered yellow caseous nodules up to 2 mm. In the left bronchial gland there were a few yellow gritty tubercles up to a millet-seed in size. The infra-bronchial glands showed single caseous tubercles. The glands about the trachea and one within the bifurcation were normal.

The long mediastinal gland contained a few caseo-calcareous tubercles up to a hemp-seed. In a second mediastinal gland there was a caseous miliary tubercle and a caseous focus in a third.

Heart and Pericardium.—Normal.

Diaphragm.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Stomach and Gastric Glands.—Normal.

Intestines.—In a Peyer's patch in the ileum there was a translucent nodule the size of a wheat grain with a yellow gritty centre. The intestines were otherwise normal.

Mesenteric Glands.—In an anterior mesenteric gland there was a single caseo-calcareous tubercle the size of a rape-seed. There was a similar tubercle in a colic gland. The rest were normal.

Spleen.—The spleen (10 ozs.) was normal.

The Liver and Portal Glands were normal.

The Kidneys, Suprarenal Bodies, and Renal Lymphatic Glands were normal.

Urinary Bladder and Testicles.—Normal.

Special Lymphatic Glands.

The Coeliac, Lumbar, and Iliac Glands were normal.

The Precural, Gluteal, Popliteal, Ischiatic, Submaxillary, Parotid, Retro-pharyngeal, and Haemo-lymph Glands were normal.

Microscopical Examinations.

(Smear preparations):—

Mesenteric Gland.—One tubercle bacillus.

Left reniform Prepectoral Gland.—Two tubercle bacilli.

Intestine (Nodule from Ileum).—No tubercle bacilli.

Colic Gland.—No tubercle bacilli.

CALF 1033.

First Protective Inoculation—April 3, 1906; subcutaneous inoculation on the right side of the neck of 50 milligrammes of culture derived from Virus H. 8. "S.C." (Mesenteric glands).

Second Protective Inoculation—May 28, 1906. [55 days later]. Intravenous inoculation into the left jugular vein of 50 milligrammes of culture derived from Virus H. 56. "F.T." (lung) through G.P. 1682.

Resistance-test Inoculation—July 26, 1906. [59 days after 2nd protective inoculation]. Subcutaneous inoculation on the left side of the neck of 50 milligrammes of culture derived from Virus B. XXVI. (Bronchial gland).

Weight at beginning of Experiment—3 qrs. 17 lbs. [Age about 8 weeks.]

Killed when well—October 24, 1906. [204 days after the first protective inoculation, and 90 days after the resistance-test inoculation.]

Clinical Notes.

First Protective Inoculation.—A small tumour of the usual non-infiltrating type developed at the seat of inoculation, and the adjacent prescapular gland became slightly enlarged.

The calf remained well, and there was no rise of temperature following the inoculation.

Second Protective Inoculation.—The temperature rose to 40.3°C. within 24 hours of the intravenous inoculation, and remained high for three days (*see chart*). It was afterwards normal. The calf remained in good health, apart from a transient constitutional disturbance accompanying the rise of temperature.

Resistance-test Inoculation.—Nine hours after inoculation the temperature rose to 39.9°C., and reached a maximum (40.5°C.) twenty-one hours after inoculation. After this it slowly returned to the normal (*see chart*).

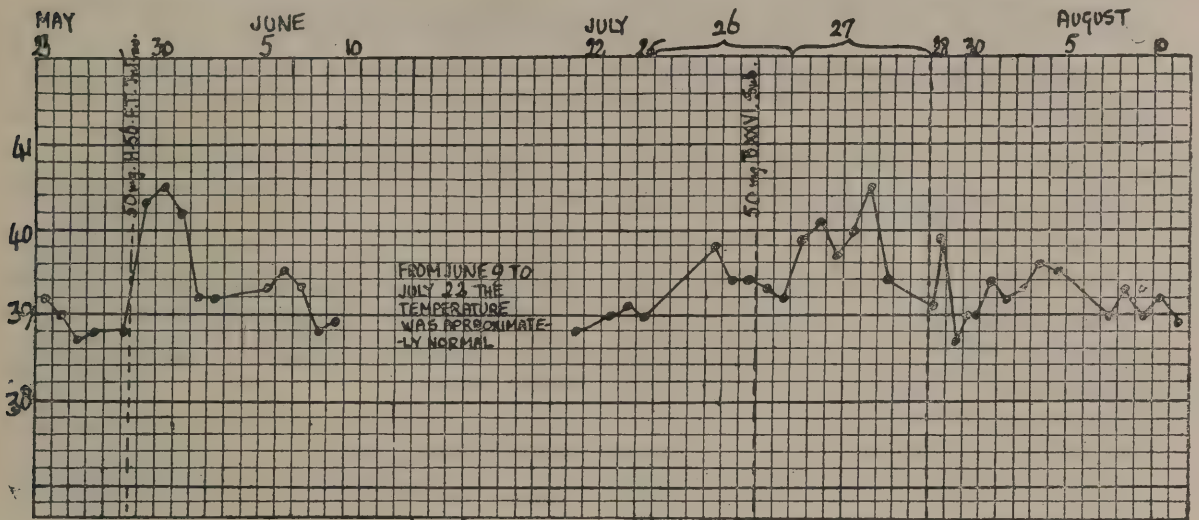
Twenty-four hours after the inoculation a slightly raised local thickening could be felt, measuring 3 in. by $1\frac{1}{2}$ in., and the left prescapular gland was slightly enlarged.

On the 13th day there was a slightly raised local tumour measuring 3 in. by $1\frac{1}{2}$ in., and the prescapular gland was slightly enlarged.

On the 28th day the tumour was cystic, measuring $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in., by about 1 in. thickness, and the gland was only very slightly enlarged. The calf was in good health, and the temperature normal (38.7°C.). No important change took place subsequently in the local conditions, and the calf remained well; it was killed 90 days after the resistance-test inoculation. After the initial rise recorded above, the temperature remained approximately normal until the animal was killed, the maximum range of variation being 38.3°C.—39.6°C.

Temperature

The temperatures immediately subsequent to the second protective and the resistance-test inoculations are given on the chart.



Each vertical division of the chart under the brackets represents an interval of three hours; elsewhere in the chart each division represents one day.

Weights.

	cwt.	qrs.	lbs.	
April 3, 1906	...	0	3	17 First protective inoculation.
May 28, 1906	...	1	1	3 Second protective inoculation.
July 26, 1906	...	1	2	6 Resistance-test inoculation.
October 24, 1906	2	1	4	Killed.

The calf gained weight steadily during the entire period of the experiment, the total gain being 1 cwt. 1 qr. 15 lbs. [Average rate of gain per week, 5.3 lbs.]

POST-MORTEM EXAMINATION.

Condition.—Good.

First Protective Inoculation.—On the right side of neck in the subcutaneous tissue there was a rounded prominent tumour about the size of a pheasant's egg. This on section consisted of a smooth-walled fibrous cyst containing caseo-pus.

Right Prescapular Gland.—The right prescapular gland measured $2\frac{1}{2}$ in. by 1 in. by $\frac{1}{2}$ in. On section the cortex was a little firm showing minute petechial hæmorrhages. There were a few caseo-calcareous tubercles the size of pin heads and an occasional minute caseous focus.

The Right Prepectoral, Axillary and Cervical Glands.—Normal.

Resistance-test Inoculation.—On the left side of the neck in the subcutaneous tissues there was an oval prominent tumour measuring $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. On section it consisted of a cyst with fibrous walls, lined internally by a thin layer of translucent tissue, and containing a mucoid caseo-purulent substance. The walls internally were crossed by tissue trabeculae, dividing them into loculae.

Left Prescapular Gland.—The left prescapular gland measured $2\frac{1}{2}$ in. by 1 in. by $\frac{1}{2}$ in. On section it contained at one extremity an irregular caseous

nodule 1 cm. in diameter, and discrete minute caseous foci in part of the cortex. The rest of the gland, about one-third, was quite normal.

Left Prepectoral Gland.—A left prepectoral gland contained a few caseo-calcareous grains.

Left Cervical Gland.—The left inferior cervical gland showed at one extremity a slightly firm patch containing discrete minute irregular caseous foci.

Left Axillary Gland.—Normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were pink in colour and crepitant. The right anterior lobe was normal; the tongue-shaped piece contained one pinhead translucent tubercle. The middle lobe was normal. The right caudal lobe showed five pinkish grey nodules up to a wheat grain in size, and two rather larger nodules with minute central caseous foci. The left anterior lobe contained four grey nodules not larger than a wheat grain which had in the centre minute caseous foci and a zone of congestion around. In the left caudal lobe there were six grey tubercles not larger than a millet seed.

Bronchial and Mediastinal Glands.—Normal.

Heart and Pericardium.—Normal.

Abdomen.

Peritoneum and Omentum.—Normal.

Stomach and Intestines.—Normal.

Gastric, Mesenteric, and Colic Glands.—Normal.

Spleen, Liver, and Portal Glands.—Normal.

Kidneys, Suprarenal Bodies and Renal lymphatic Glands.—Normal.

Various Lymphatic Glands.—Lumbar, iliac, coeliac, precucal, pudic, gluteal, popliteal, submaxillary, parotid, and retropharyngeal glands: Normal.

CALF 1035.

First Protective Inoculation—April 3, 1906; Subcutaneous inoculation on the right side of the neck of 50 milligrammes of culture derived from Virus H 8 "S.C." (Mesenteric glands).

Second Protective Inoculation—May 28, 1906. [55 days later.] Intravenous inoculation into the left jugular vein of 50 mg. of culture derived from Virus H 56 "F.T." (lung) through G.P. 1682.

Resistance-test Inoculation—July 26, 1906. [59 days after second protective inoculation]. Subcutaneous inoculation on the left side of the neck of 50 mg. of culture derived from Virus B. XXVI. (Bronchial glands).

Weight at beginning of Experiment—1 cwt. 0 qr. 14 lbs. [Age about 12 weeks.]

Killed when well—October 25, 1906. [205 days after the first protective inoculation and 91 days after the resistance-test inoculation.]

Clinical Notes.

First Protective Inoculation.—A small tumour of the usual non-infiltrating type developed at the seat of inoculation, and the right prescapular gland became slightly enlarged. The calf remained well, and there was no rise of temperature.

Second Protective Inoculation.—The temperature rose to 41.4°C. within 24 hours of the intravenous inoculation (see chart). It slowly fell, and afterwards remained normal. The calf remained well, except for slight constitutional disturbance accompanying the rise of temperature.

Resistance-test Inoculation.—Nine hours after inoculation the temperature rose to 40.0°C. and reached a

maximum—40.5°C.—forty hours after inoculation. It then rapidly fell to normal (see chart).

Twenty-four hours after the inoculation, an ill-defined tender thickening could be felt, measuring 3 in. by 2 in. The adjacent prescapular gland was slightly enlarged.

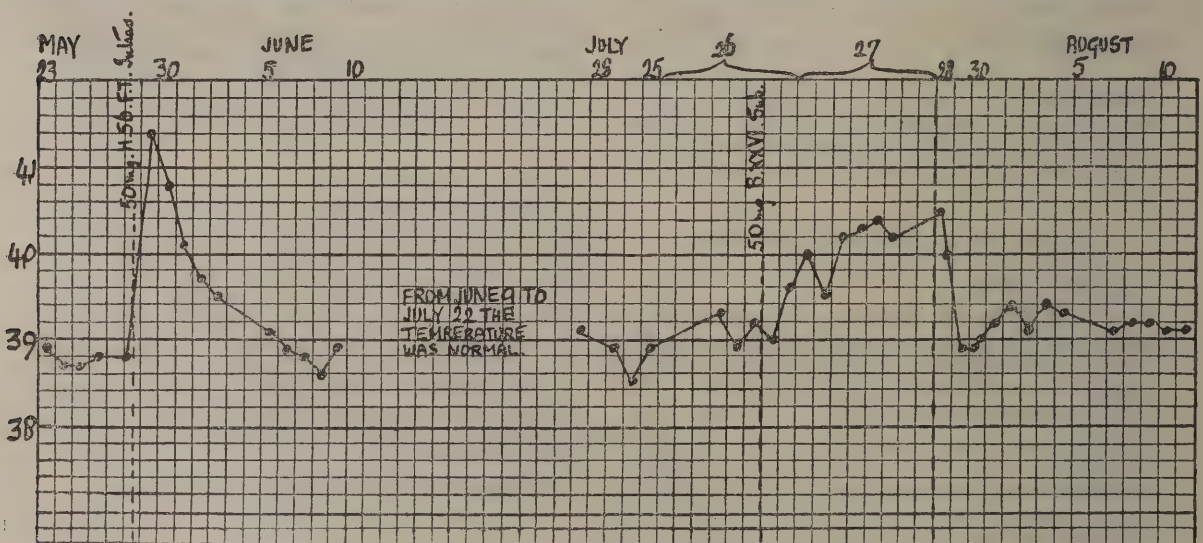
On the 13th day there was a slight thickening at the seat of inoculation, 3 in. by 1½ in.; the prescapular gland was slightly enlarged.

On the 28th day the local conditions were unchanged; the calf was in good health, and the temperature normal.

On the 50th day there was a softened swelling at the seat of inoculation, 2½ in. by 1½ in.; the prescapular gland was 2 in. long. The calf remained well, and the temperature normal, and on the 91st day after the resistance-test inoculation, the animal was killed.

Temperature.

The temperatures immediately following the second protective and resistance-test inoculations are given in the chart. From August 12 to October 25, when the calf was killed, the temperature was approximately normal.



Each vertical division of the chart under the brackets represents an interval of three hours; elsewhere in the chart each division represents one day.

Weights.

	cwt.	qrs.	lbs.	
April 3, 1906	...	1	0 14	First protective inoculation.
May 28, 1906	...	1	2 6	Second protective inoculation.
July 26, 1906	...	1	3 17	Resistance-test inoculation.
October 25th, 1906	...	2	1 19	Killed.

The calf gained weight steadily during the entire period of the experiment, the total gain being 1 cwt. 1 qr. 5 lbs. [Average rate of gain per week, 5 lbs.]

POST-MORTEM EXAMINATION.

Condition.—Good.

First Protective Inoculation.—On the right side of the neck in the subcutaneous tissue there was a rounded prominent tumour about the size of a

pheasant's egg, not infiltrating either skin or muscle. On section it was a cyst with almost smooth walls internally containing a caseo-purulent slightly gritty substance.

Right Prescapular Gland.—The right prescapular gland measured 2 in. by 1 in. by ½ in. On section there were in the superficial part of the cortex two patches of caseous gritty tubercles up to the size of a millet seed. The rest of the gland except for an occasional caseous focus beneath the capsule was normal.

The Right Prepectoral, Axillary and Cervical Glands were normal.

Resistance-Test Inoculation.—On the left side of the neck in the subcutaneous tissues there was a pear-shaped swelling measuring 3½ in. by 1½ in. by 1 in. Although adherent to skin and muscle it did not infiltrate and could be readily dissected away; in the muscle were three isolated caseous tubercles. On

section the tumour consisted of a thin walled fibrous cyst, which was lined internally by translucent tissue beset with soft caseous streaks and contained caseous pus.

Left Prescapular Gland.—The left prescapular gland, $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in. by $\frac{1}{2}$ in., contained on section in the cortex three patches measuring from 1 c.m. to 1.5 c.m. composed of closely aggregated gritty caseous streaks and foci. Parts of the gland were quite normal; the rest showed sparsely scattered irregular caseous foci.

Left Prepectoral Glands.—The left prepectoral glands were normal.

Left Axillary Gland.—Normal.

Left Cervical Glands.—The left inferior cervical gland, 2 c.m. in diameter, contained a firm grey nodule with a caseous gritty network replacing half the gland. Of the other half the margin of the cortex was caseated. In the midcervical region there was a gland a little firm and partly filled with a caseous network.

Thorax.

Pleura normal.

Lungs.—The lungs were pink and crepitant and contained scattered nodules, the majority about one centimetre in diameter, occurring both on the surface and in the substance. They were irregular in outline and corresponded with a lobule or part of a lobule. Some were reddish in colour, others grey with reddish margins.

On section the more advanced nodules consisted of grey tissue with a caseous gritty network in the centre and a margin of consolidated lung tissue around. The smaller nodules were made up of pinkish grey tissue with caseous foci.

Thoracic glands.—The caudal mediastinal gland measured $4\frac{1}{2}$ in. in length and 1 in. at its widest part. The cortex was a little firm and contained in the superficial part discrete yellow caseous sometimes gritty foci.

The other mediastinal glands were a little enlarged and firm, and showed in the cortices discrete caseous foci with occasionally an indication of the formation of a fine caseous network.

The bronchial glands were similar to the mediastinal glands, those on the right showing more numerous caseous foci.

Pericardium, Heart, and Diaphragm.—Normal.

Abdomen.

Peritoneum and Omentum.—Normal.

Stomach and Intestines.—Normal.

Gastric, Mesenteric, and Colic Glands.—Normal.

Spleen.—The spleen weighed 7 oz. In the substance were three tubercles, two the size of millet seeds and one the size of a hemp-seed. They were easily picked out, and consisted of firm translucent tissue with caseous gritty centres.

Liver.—In the centre of the liver in the fibrous capsule of a portal system there was a yellow gritty nodule in a thin translucent capsule the size of a wheat grain.

Portal Glands.—Normal.

Kidneys, Suprarenal Bodies, and Renal lymphatic Glands.—Normal.

Lumbar and Iliac Glands.—Normal.

Tongue, Pharynx, Larynx, and Tonsils.—Normal.

Various Lymphatic Glands.

Preaural, Gluteal, Popliteal, Pudic, Parotid, Submaxillary, Retro-Pharyngeal, and Ventral Mediastinal Glands.—Normal.

Microscopical Examination.

(Smear preparation.)

Nodule from liver.—No tubercle bacilli.

CALF 923.

First Protective Inoculation—October 4, 1905; subcutaneous inoculation on the right side of the neck of 10 milligrammes of culture derived from Virus H 54 "C.W." (Spleen) through G.P. 1609.

Second Protective Inoculation—April 3, 1906. [181 days after 1st protective inoculation.] Subcutaneous inoculation on the right side of the neck of 50 mg. of culture derived from Virus H 8 "S.C." (Mesenteric glands).

Resistance-test Inoculation—June 5, 1906. [63 days after 2nd protective inoculation.] Subcutaneous inoculation on the left side of the neck of 50 mg. of culture derived from Virus B XXVI. (Bronchial glands).

Weight at commencement of Experiment—1 cwt. 0 qrs. 23 lbs. [Age about 13 weeks.]

Died—July 11, 1906. [280 days after the first protective inoculation, and 36 days after the resistance-test inoculation.]

Clinical Notes.

First Protective Inoculation.—A small fluctuating tumour of the usual non-infiltrating type developed at the seat of inoculation, and the prescapular gland became slightly enlarged. The temperature rose to 40.0°C . on the 7th day, and remained high for three weeks; it was afterwards normal. The calf was quite well.

Second Protective Inoculation.—A tumour developed at the seat of inoculation of similar character to the first. The temperature was a little irregular during the fortnight following the injection, but was afterwards quite normal. The general health of the animal was unaffected.

Resistance-test Inoculation.—Twelve hours after the inoculation the temperature rose to 40.0°C . It continued to rise, and reached a maximum— 40.9°C .—48 hours after inoculation (see chart).

Twenty-four hours after inoculation a slight local thickening only could be felt.

On the fourth day there was a small raised thickening $1\frac{3}{4}$ in. in diameter and the prescapular gland was slightly enlarged.

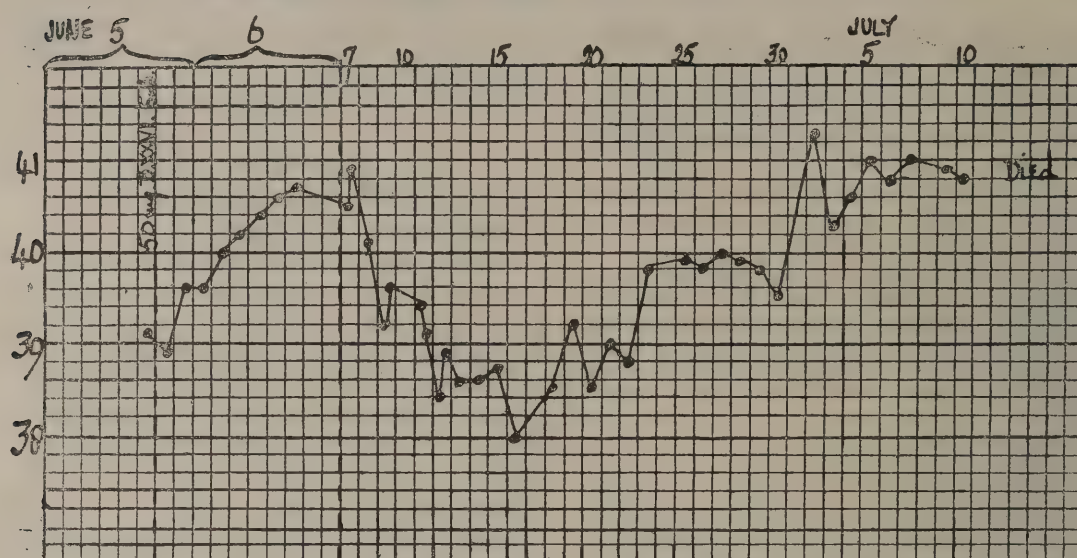
On the 14th day after inoculation the swelling was firm, prominent, and pearshaped, measuring 3 in. by 2 in. The prescapular gland was enlarged, 3 in. in length. A week later the swelling was soft and fluctuating throughout.

On the 27th day the temperature rose to 41.3°C ., and on the next morning the respirations were noticed to be increased in frequency; the rate of respiration continued frequent, and on the 31st day the animal was obviously ill, standing with arched back and roughened coat.

On the 35th day the rate of respiration was 132 per minute; the head was extended, the mouth open, and the lips and alae nasi opened widely during inspiration. The temperature was very high, 40.8°C . The following day the calf died.

Temperature.

The temperatures following the resistance-test inoculation are shown below :—



Each vertical division of the chart under the brackets represents an interval of three hours; elsewhere in the chart each division represents one day.

Weights.

		cwt.	qrs.	lbs.
October 4, 1905	...	1	0	23
April 3, 1906	...	2	2	26
June 25, 1906	...	3	1	0
July 11, 1906	...	2	2	15

The calf increased in weight during the first 8½ months, gaining 2 cwt. 0 qrs. 5 lbs. From June 25 to July 11, 1906, it lost 2 qrs. 13 lbs.

Tuberculin Test.—March 30, 1906. 146 days after 1st protective inoculation. Reacted. Rise of temperature 1.4°C.

POST MORTEM EXAMINATION.

Carcass.—Emaciated.

Protective Inoculations.—In the subcutaneous tissues no the right side of the neck there was a cyst about the size of a pigeon's egg, with thin fibrous wall, lined internally with granulation tissue and caseo-purulent contents.

In the subcutaneous tissues a few inches posterior to the above there was a small fibrous nodule, brownish and translucent in the centre and beset with yellow calcareous particles, denser and whiter around the margins.

Resistance-test Inoculation.—On the left side of the neck there was a soft fluctuating swelling, somewhat pear-shaped in outline, measuring 2½ in. by 2½ in. by 1 in.; on section it was composed of a series of communicating cavities, filled with soft yellow caseo-pus; around the cavities there was a layer of reddish firm tissue, nowhere very thick, containing yellow streaks and foci of necrosis; the internal surface of each cavity was covered with a thin yellow adherent membrane.

Right Prescapular Gland.—The right prescapular gland measured 2½ in. by ¾ in. by ½ in., and showed in the cortex about half-a-dozen calcareous nodules, the largest the size of a hempseed, composed of aggregations of calcareous particles set in a soft brownish translucent matrix.

Left Prescapular Gland.—The left prescapular gland measured 3½ in. by 2 in. by 1 in.; on section part of the cortex was composed of translucent slightly congested fibroid tissue containing ramifying tracks and irregular patches of caseo-necrotic substance, in many places softened and breaking down; the rest of the cortex, except at one extremity, where it was normal, was deeply congested and closely beset with yellow caseous miliary tubercles.

Prepectoral Glands.—One on the left side, the size of a broad bean, was cedematous and showed in the centre a moderate number of discrete yellow caseous tubercles, the largest 1 mm. in diameter, with deeply congested margins. Other prepectoral glands were normal.

Cervical Glands.—A lower cervical gland on the left side was closely beset with tubercles similar to those in the prepectoral gland. A gland in the middle of the neck on this side, the size of a pheasant's egg, showed the greater part of the substance dense yellow and caseous; the rest was greyish red and closely studded with caseous foci. A small gland just in front of the latter contained numerous small congested yellow tubercles. The left upper cervical glands and all the cervical glands on the right side of the neck were normal.

Thorax.

Lungs.—The lungs did not collapse, and almost completely filled the chest; they were heavy, and weighed with attached glands 20 lbs. 6 ozs.

The cephalic lobes, the right middle lobe and a large portion (antero-ventral) of each caudal lobe were firm, dark red, and quite airless; they were studded on the surface with slightly raised greyish nodules, the largest the size of a hempseed; on section these solid portions were found to be closely beset with grey nodules, irregular in outline, ranging in size from a mere point up to that of a hempseed (2 mm. or rather more in diameter); the larger nodules were speckled with minute yellow points, the smaller ones had minute opaque yellow centres. The nodules remained for the most part discrete, but had here and there coalesced. The posterior and dorsal portions of the caudal lobes were still air containing and showed commencing interstitial emphysema; they contained nodules similar to those in the consolidated lobes, but not so numerous.

Thoracic Glands.—The tissues around the dorsal mediastinal glands were very emphysematous.

The mediastinal and bronchial glands were enlarged, and together weighed 9½ ozs.; the caudal mediastinal gland measured 5 in. by 2 in. by about 1 in.

On section the mediastinal glands showed their cortices firm and greyish, as if infiltrated with confluent grey tubercles, and the medullary portions deeply congested; scattered about in the cortices were yellow caseous miliary tubercles. The right bronchial gland resembled the mediastinal glands. The cortex of the left bronchial gland was less uniformly grey and showed discrete grey nodules and patches containing caseous foci; the medulla was soft and almost diffuent.

Pleura.—There was slight hypertrophy of the fringes along the margins of the ribs and on the diaphragm, but no tubercles could be felt.

Heart.—The pericardial sac contained a slight excess of fluid. The epicardium showed a few patches of reddish velvety vegetation. The heart muscle and valves were normal. The cavities were filled with red blood clot.

Larynx and Trachea.—Normal.

Abdomen.

Omentum and Peritoneum.—Normal.

Spleen.—Weight 1 lb. 6 ozs. No tubercles were seen on the surface or on section; the pulp was dark red and moderately firm, and the Malpighian bodies could not be differentiated.

Liver.—The liver was normal in general appearance; it showed throughout the substance very sparsely scattered minute opaque spherical tubercles.

Portal Glands.—One contained three or four greyish white foci, not calcareous; two others contained each one caseous focus.

Kidneys.—Both kidneys showed on the surface

sparsely scattered greyish translucent foci, the largest not quite 1 mm. in diameter; similar foci were seen on section.

Suprarenal Bodies.—The left suprarenal body showed in the cortex four miliary tubercles with yellow caseous centres and grey margins; there were a few similar tubercles in the right suprarenal.

Alimentary Tract.

Tonsils, Pharynx.—Normal.

Submaxillary, Retro-pharyngeal, and Parotid Glands were deeply congested, but did not contain tubercles.

Intestines.—Normal.

Gastric, Mesenteric, and Colic Glands.—Normal.

Various Lymphatic Glands.

The Right Precurural Gland showed in the cortex a yellow caseous focus.

The Left Precurural, Pudic, Celiac, Lumbar, Sacro-iliac, and Gluteal Glands were normal.

The Left Iliac Gland showed two or three yellow foci in the cortex; there was one yellow point in the cortex of the right iliac gland.

CALF 925.

First Protective Inoculation—October 4, 1905. Subcutaneous inoculation on the right side of the neck of 10 milligrammes of culture derived from Virus H 54 "C.W." [Spleen] through G.P. 1609.

Second Protective Inoculation—April 3, 1906. [181 days after first protective inoculation.] Subcutaneous inoculation on the right side of the neck of 40 mg. of culture derived from Virus H 8 "S.C." (Mesenteric glands).

Resistance-test Inoculation—June 5, 1906. [63 days after second protective inoculation.] Subcutaneous inoculation on the left side of the neck of 50 mg. of culture derived from Virus B. XXVI. (Bronchial glands).

Weight at beginning of Experiment—1 cwt. 0 qr. 25 lbs. [Age about 13 weeks.]

Killed when well—September 3, 1906. [334 days after the first protective inoculation, and 90 days after the resistance-test inoculation.]

Clinical Notes.

First Protective Inoculation.—A small tumour of the usual non-infiltrating type developed at the seat of inoculation and the prescapular gland became slightly enlarged. The temperature rose to 40.0°C. on the tenth day, and remained high for eleven days. After this it was normal. The general health of the calf was unaffected.

Second Protective Inoculation.—This inoculation was made on the same side of the neck as the first, and a tumour developed similar in character to it. The temperature remained normal, and the calf was quite well. Two months after the second inoculation the tumour produced by it was the size of a goose's egg; that produced by the first inoculation was smaller, measuring 2½ in. by 1½ in.

Resistance-test Inoculation.—The temperature

remained normal for 24 hours. Forty hours after inoculation it rose to 40.0°C., and eight hours later to 40.6°C. The following day it was almost normal. (See chart.)

Within 24 hours of the inoculation there was a tender, hot, ill-defined oedematous local swelling 3 in. in greatest diameter.

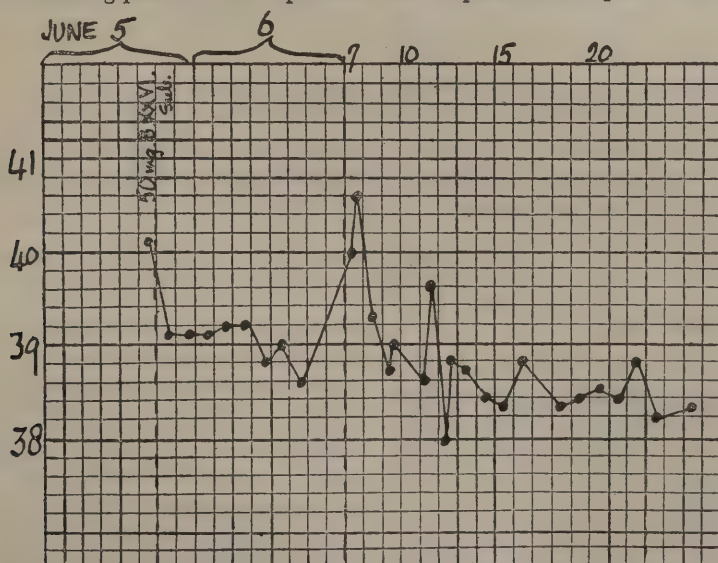
A fortnight after inoculation, a firm, subcutaneous local thickening could be felt, 3 in. by 1½ in.; the prescapular gland was 3 in. in length. The calf was quite well and the temperature was normal.

On the 38th day there was a softened tumour at the seat of inoculation, 3 in. by 1½ in.; the gland was slightly enlarged.

On September 3rd, 90 days after inoculation, the calf was killed when in good health. The temperature had been normal subsequent to the rise recorded above.

Temperature.

The temperature during the fortnight following the resistance-test inoculation is given in the chart below. During the remaining period of the experiment the temperature was quite normal.



NOTE Each vertical division of the chart under the brackets represents an interval of three hours; elsewhere in the chart each division represents one day.

Weights.

			cwt.	qrs.	lbs.
October 4, 1905	...	...	1	0	25
April 3, 1906	...	...	2	2	0
June 25, 1906	...	...	3	1	3
September 3, 1906	...	...	3	3	21

The calf gained weight steadily during the experiment, the total increase during eleven months being 2 cwt. 2 qrs. 24 lbs. (average rate of gain per week : 5·3 lb.).

Tuberculin Test.—March 30, 1906. 146 days after first protective inoculation. Reacted. Rise of temperature, 1·7°C.

POST-MORTEM EXAMINATION.

Condition.—Good.

Protective Inoculations.—On the right side of the neck in the subcutaneous tissue there were two tumours.

The anterior one was rounded and measured 2½ in. by 2½ in. by 1½ in. On section it consisted of a cyst with a fibrous wall adherent to but not infiltrating skin and muscle. It was filled with soft yellow caseous and the walls were lined by reddish granulation tissue upon which there was a network composed of vessels and fibrous cords.

The posterior tumour measured 3 in. by 2 in. by 1 in. and consisted of tough white scar tissue with a few scattered calcareous foci in the deeper part.

Right Prescapular Gland.—The right prescapular gland measured 2½ in. by 1½ in. by ¾ in. On section it contained one pea-sized nodule consisting of a collection of calcareous grains. The rest of the gland was normal except for scattered foci of congestion.

The Right Prepectoral, Axillary, and Cervical Glands were normal.

Resistance-test Inoculation.—On the left side of the neck in the subcutaneous tissues there was a flattened tumour measuring 3½ in. by 1½ in. by 1½ in. adherent to skin and muscle. There was no infiltration of the muscle and only an occasional soft caseous focus in the skin. On section the tumour contained a yellow caseo-purulent substance; the walls were composed of translucent fibrous tissue lined by dark red granulation tissue.

Left Prescapular Gland.—The left prescapular gland measured 3 in. by 1½ in. by ¾ in. Around the cortex were numerous small haemorrhagic foci collected mainly into patches, many of which showed minute grey and opaque gritty foci. There were also in the cortex two irregular soft caseous gritty nodules, the larger 2 cm. by 1 cm., the smaller 1 cm. by 5 mm. They were surrounded by zones of congestion and had a tendency to shell out.

Left Prepectoral Glands.—The left prepectoral glands were slightly enlarged and showed in the cortices haemorrhagic foci, one of which was slightly gritty.

The Left Axillary and Cervical Glands were normal.

Thorax.

Pleura.—Normal.

Lungs.—On the surfaces of the lungs there were scattered haemorrhagic foci and occasional dark red spots about 1 mm. in diameter. The substance of the lungs was normal.

Thoracic Glands.—One mediastinal gland contained a yellow caseo-calcareous tubercle the size of a rape seed. The other mediastinal glands and the bronchial glands were normal except for occasional haemorrhagic foci.

Heart and Pericardium.—Normal.

Abdomen.

Peritoneum and Omentum.—Normal.

Stomachs and Intestines, Gastric and Colic Glands.—Normal.

Mesenteric Glands.—There were scattered haemorrhagic foci in the mesenteric glands.

Spleen.—The spleen weighed 18 ozs. On section there was in the substance a single grey nodule 3·5 mm. in diameter containing a calcareous grain in the centre.

Liver and Portal Glands, Lumbar and Iliac Glands.—Normal.

Kidneys, Suprarenal Bodies, and Renal lymphatic Glands.—Normal.

Tongue, Pharynx, Tonsils, Larynx, and Trachea.—Normal.

Various Lymphatic Glands.

Precrural, Popliteal, Gluteal, Ischiatic, Pudic, and Submaxillary Glands.—Normal.

The Parotid and Retro-Pharyngeal Lymphatic Glands showed a few foci of congestion.

Microscopical Examinations.

(Smear preparations):—

Haemorrhagic foci from Left Prepectoral Gland.—No tubercle bacilli.

Haemorrhagic foci from Mesenteric Gland.—No tubercle bacilli.

CALF 414.

Protective Inoculation—June 5, 1906; subcutaneous inoculation on the left side of the neck of 0·001 milligramme of culture derived from Virus B. XXVI. (Bronchial glands).

Resistance-test Inoculation—July 26, 1906. [51 days after protective inoculation.] Subcutaneous inoculation on the right side of the neck of 50 mg. of culture derived from same source, Virus B. XXVI.

Weight at beginning of Experiment—2 qrs. 23 lbs. [Age about 5 weeks.]

Died—October 21, 1906. [138 days after the protective inoculation, and 87 days after the resistance-test inoculation.]

Clinical Notes.

Protective inoculation.—On the fourth day nothing could be felt at the seat of inoculation; on the 13th day there was a slight ill-defined thickening. On the 21st day there was a definite though small localised thickening. On the 38th day the local thickening had not increased in size, but the adjacent prescapular gland was slightly enlarged.

For 30 days following the inoculation the temperature remained normal; there was then a slight rise (maximum 39·8°C.) lasting ten days, after which the

temperature was again normal. The general health of the calf was unaffected.

Resistance-test Inoculation.—Nine hours after inoculation the temperature rose to 40·2°C., and reached a maximum of 41·1°C. forty-eight hours after inoculation. After this it rapidly fell to normal. (See chart.)

Twenty-four hours after the inoculation there was a flat tender oedematous thickening 2½ in. in greatest width extending towards the dewlap.

On the 13th day there was a flat thickening 2 in.

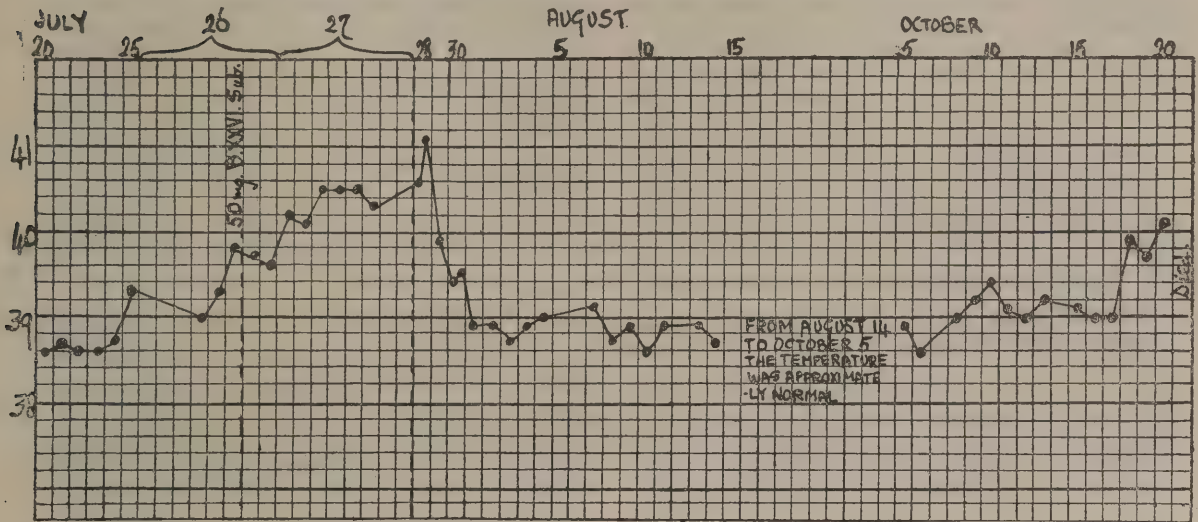
in greatest diameter, and the adjacent prescapular gland was slightly enlarged.

On the 50th day there was a softened tumour at the seat of inoculation, the size of a hen's egg, and the prescapular gland was slightly enlarged. The calf was in fairly good condition; the temperature was 38.4°C.

On the 87th day the calf died. It had not been obviously ill, but its condition had been poor for some time; on this day it became very ill, lying down with its head turned on to the left shoulder; it died in the evening. The temperature had usually been a little above the normal (maximum 39.4°C.); during the last three days it was high (about 40.0°C.).

Temperature.

The temperature subsequent to the resistance-test inoculation is shown on the chart.



Each vertical division of the chart under the brackets represent an interval of three hours; elsewhere in the chart each division represents one day.

Weights.

	qrs.	lbs.	
June 5, 1906	...	2 23	Protective inoculation.
June 25, 1906	...	3 5	
July 26, 1906	...	3 17	Resistance - test inoculation.
October 21, 1906	...	3 11	Died.

During the first 51 days (the period covered by the protective inoculation) the calf gained weight (22 lbs.). It lost 6 lbs. subsequent to the resistance-test inoculation.

POST-MORTEM EXAMINATION.

Condition.—Good.

Protective Inoculation.—On the left side of the neck in the subcutaneous tissues there was an oval flattened tumour measuring 1½ in. by 1 in. by ½ in. It was adherent to skin and muscle but did not infiltrate. On section it was composed almost entirely of firm caseous tissue containing calcareous streaks and granules.

Left Prescapular Gland.—The left prescapular gland measured 2½ in. by 1½ in. by ¾ in. On section about two-thirds of the cortex was replaced by firm caseo-calcareous tissue with a translucent fibroid margin. The rest of the gland contained irregular caseo-calcareous tubercles.

Left Prepectoral Glands.—Two left prepectoral glands were normal. A third the size of a pea contained scattered caseous foci in the cortex.

Left Axillary and Cervical Glands.—Normal.

Resistance-test Inoculation.—On the right side of the neck there was a roughly circular tumour 2 in. in diameter and ¾ in. in thickness. On section it consisted of a cyst filled with caseo-pus; the walls were covered with an adherent caseous lining which when stripped away left reddish granulation tissue.

Right Prescapular Gland.—The right prescapular gland measured 2½ in. by 1½ in. by ½ in. It was firm and on section about two-thirds of the cortex was filled with discrete caseous slightly gritty tubercles.

In the remainder of the gland there were a few scattered caseous tubercles. The tissues around the gland were oedematous.

Right Prepectoral Glands.—The right round prepectoral gland had the outer margin of the cortex filled with caseo-calcareous confluent tubercles leaving the centre free. Right reniform prepectoral gland normal.

Right Axillary Gland.—Normal.

Right Cervical Glands.—The right inferior cervical gland, 1½ in. in length, had the greater part of its substance filled with caseo-calcareous tubercles mainly discrete and up to a millet seed in size. The right middle and superior cervical glands were normal.

The subcutaneous tissues of the neck were extremely oedematous.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were oedematous and somewhat congested, but contained no tuberculous foci.

Thoracic Glands.—A left tracheo-bronchial gland showed a caseo-calcareous miliary tubercle. Other bronchial glands on both sides were normal.

The caudal mediastinal gland showed one opaque gritty tubercle. The neighbouring gland contained a collection of caseo-calcareous foci the size of a wheat grain. Other mediastinal glands were normal.

The tissues in the anterior mediastinum were oedematous.

Heart, Pericardium, and Diaphragm.—Normal.

Abdomen.

Omentum and Peritoneum, Intestines, Gastric, Mesenteric and Colic Glands.—Normal.

Spleen.—The spleen weighed 4 ozs. The surface appeared normal. In the substance there were three tubercles, in size from a hemp seed to a wheat grain. On section they consisted of softened caseous gritty substance, enclosed in a translucent capsule.

Liver and Portal Glands.—Normal.

Gall-bladder.—The gall-bladder was greatly distended, measuring 6½ in. by 3 in. Slight pressure caused fluid to escape from the duct. The walls of the bladder were thin, but otherwise normal, and the contained fluid was yellowish and mucinous.

Kidneys.—The cortices were normal; the pelves were oedematous.

At the termination of the left ureter, where it enters the bladder, there was a cystic dilatation, the size of an orange, filled with yellow caseo-purulent substance. The walls of the cyst were smooth, and it appeared completely shut off. The ureter above was not dilated.

Suprarenal Bodies and Renal Lymphatic Glands, Lumbar and Iliac Glands.—Normal.

The tissues of the pelvis were oedematous.

Tongue and Tonsils.—Normal.

Pharynx and Larynx.—The pharynx and larynx were slightly congested.

Special Glands.

Precrural, Pudic, Gluteal, Popliteal, Submaxillary, Parotid, Retro-Pharyngeal, Coeliac, and Ischiatic Glands.—Normal.

CALF 416.

Protective inoculation.—June 5, 1906; subcutaneous inoculation on the left side of the neck of 0·001 milligramme of culture derived from Virus B. XXVI. (Bronchial glands).

Resistance-test Inoculation.—July 26, 1906. [51 days after protective inoculation.] Subcutaneous inoculation on the right side of the neck of 50 milligrammes of culture derived from same source, Virus B. XXVI.

Weight at beginning of Experiment.—3 qrs. 5 lbs. [Age about 5 weeks.]

Killed when well.—October 23, 1906. [140 days after the protective inoculation, and 89 days after the resistance-test inoculation.]

Clinical Notes.

Protective Inoculation.—On the fourth day nothing could be felt at the seat of inoculation; on the 14th day there was a slight ill-defined thickening; on the 21st day a definite though very slight thickening could be felt. There was no further change in the local conditions. The temperature remained normal; the general health of the calf was unaffected.

Resistance-test Inoculation.—Twelve hours after inoculation the temperature rose to 39·9°C. and reached 41·2°C. 24 hours after inoculation. After this it slowly returned to the normal (*see chart*).

Twenty-four hours after the inoculation a tender ill-defined thickening could be felt, which measured

3 in. by 1½ in.; the right prescapular gland was not perceptibly enlarged.

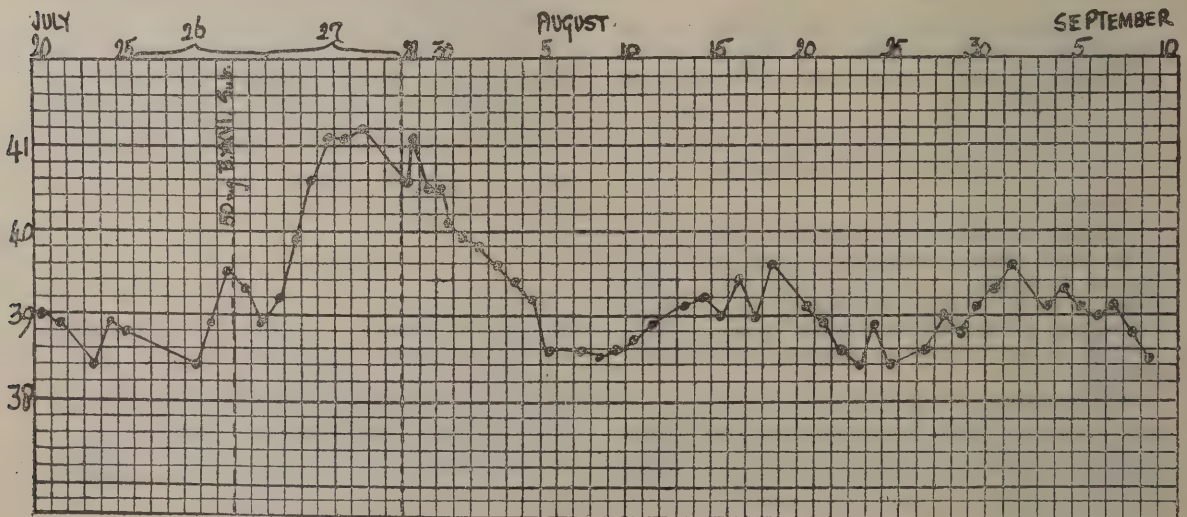
On the 13th day the flat local thickening measured 3 in. in greatest diameter, and the prescapular gland was slightly enlarged. Temperature normal (38·5°C.).

During the following month the swelling became smaller and softened, and on the 50th day measured 2 in. by 1½ in. The prescapular gland was still only slightly enlarged. The calf was in good health and the temperature normal (38·8°C.).

The animal was killed 89 days after the resistance-test inoculation. The temperature had been fairly normal since the initial rise recorded above; on two occasions it rose to 39·6°C. (*see chart*).

Temperature.

The chart shows the temperature of the calf for six weeks subsequent to the resistance test-inoculation. From September 9 to October 23 the temperature was normal.



Each vertical division of the chart under the brackets represents three hours; elsewhere in the chart each division represents one day.

Weights.

	cwt.	qrs.	lbs.	
June 5, 1906	...	0	3	5 Protective inoculation.
June 25, 1906	...	0	3	11
July 26, 1906	...	0	3	24 Resistance-test inoculation.
October 23rd, 1906	...	1	0	10 Killed.

The calf slowly increased in weight during the experiment, the total gain of weight being 1 qr. 5 lbs.
Average rate of gain per week—1·6 lbs.

POST-MORTEM EXAMINATION.

Protective Inoculation.—On the left side of the neck there was no local lesion visible.

Left Prescapular Gland.—The left prescapular gland measured 1½ in. by 1 in. One half of the gland contained several pea-sized collections of caseo-calcareous tubercles. In the other half there were only a few discrete caseo-calcareous tubercles not larger than pin-heads.

Left Prepectoral Glands.—A left round prepectoral gland was slightly enlarged and about half composed

of gritty caseous substance. Two other left prepectoral glands were normal.

Left Axillary Glands.—Normal.

Left Cervical Glands.—The left inferior cervical gland contained a few discrete caseous tubercles. Other cervical glands were normal.

Resistance-test Inoculation.—On the right side of the neck in the subcutaneous tissues there was a rounded slightly prominent tumour $2\frac{1}{2}$ in. by $\frac{3}{4}$ in. On section it consisted of a fibrous walled cyst lined internally by grey granulation tissue thinly coated with caseous substance. It was divided by strands of translucent tissue passing from wall to wall and was filled with caseo-pus.

Right Prescapular Gland.—The right prescapular gland measured $1\frac{1}{2}$ in. by $\frac{3}{4}$ in. by $\frac{1}{4}$ in. On section it contained scattered discrete soft caseous tubercles up to a pinhead in size.

The Right Prepectoral, Axillary and Cervical Glands were normal.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were somewhat voluminous. The surfaces of both showed numerous dark irregular congested patches varying from 1 mm. to 3 mm. in diameter. There were also scattered larger patches irregularly quadrilateral in shape ranging in size up to 1 cm. by 2 cm. On section the larger nodules corresponding in outline with lobules of the lung were composed of dark grey tissue with yellow caseous foci. Many of the smaller congested patches were grey in the centre with surrounding zones of congestion and some contained opaque caseous foci. The anterior lobe of the right lung was completely solid and in the condition of grey hepatitis: there could be seen throughout the tissue numerous minute caseous foci. The bronchi in this part of the lung were dilated and exuded a purulent fluid. On section the rest of the substance of the lungs showed numerous patches similar to those described on the surfaces.

Thoracic Glands.—The left bronchial glands were enlarged, and a considerable part of the cortices was composed of firm grey tissue containing irregular caseo-calcareous nodules up to a hemp-seed in size. The right bronchial glands were similar and contained discrete caseo-calcareous miliary tubercles. The caudal mediastinal gland measured 3 in. by $\frac{3}{4}$ in. On section it was deeply congested except for a narrow margin of the cortex which was firm and grey and contained numerous caseo-calcareous tubercles up to a millet-seed. The other mediastinal glands were similar.

Heart, Pericardium, and Diaphragm.—Normal.

Abdomen.

Peritoneum and Omentum.—Normal.

Stomachs.—Normal.

Intestines.—In the small intestine several of the Peyer's patches showed a few soft yellowish caseous tubercles up to a pinhead in size.

The large intestine was normal.

The Gastric, Mesenteric, and Colic Glands were normal.

Spleen.—The spleen weighed 4 oz. On section it contained one nodule the size of a hemp-seed, which consisted of translucent tissue with a soft caseous appreciably gritty centre.

Liver.—Just beneath the capsule of the liver on the convex surface there was a grey nodule the size of a wheat-grain with a caseous gritty centre. The rest of the surface was normal. On section through the substance there was one caseo-calcareous tubercle the size of a rape-seed.

Gall-bladder.—Normal.

Portal Glands.—In one portal gland there were about 20 discrete caseous gritty tubercles up to the size of a pin-head. Three other glands contained a few caseous tubercles, some soft, others gritty. One gland was normal.

Kidneys.—The kidneys showed in the superficial part of the cortices an occasional grey translucent tubercle. In the right there were also two tubercles 1 millimetre in diameter, with minute caseous centres.

Renal Glands.—The left renal gland contained a small collection of gritty caseous tubercles, and a few scattered caseous tubercles, none larger than a rape-seed, in the rest of the gland. The right renal gland showed three similar tubercles.

Suprarenal Bodies.—Normal.

Lumbar Glands.—Two lumbar glands each contained a pinhead-sized caseous tubercle. A third gland showed three smaller tubercles. Two other glands were normal.

Iliac Glands.—Normal.

Tongue, Larynx, Pharynx, and Tonsils.—Normal.

Various Lymphatic Glands.

The Left Precurral Gland contained a single translucent nodule the size of a hemp-seed, with a soft caseous centre.

Right Precurral Gland.—Normal.

Pudic, Gluteal, Popliteal, Pharyngeal, and Ischiatic Glands.—Normal.

The Right Parotid Gland showed a caseous nodule the size of a hemp seed.

Microscopical Examinations.

(Smear preparations.)

Tubercle from Kidney.—Two tubercle bacilli seen.

Tubercle from Liver.—Eight tubercle bacilli seen.

CALF 418. Control.

Subcutaneous inoculation of culture derived from the original material of Virus B. XXVI. (Bronchial glands).

Dose—50 milligrammes.

Date—June 5, 1906.

Weight—2 qrs. 8 lbs.

Died—August 20, 1906. [76 days after inoculation.]

Clinical History.

The calf was inoculated subcutaneously on the left side of the neck on June 5, 1906.

On the next day there was a slight thickening $1\frac{1}{2}$ in. in diameter. On the fourth day the thickening measured 2 by $1\frac{1}{2}$ in. and the prescapular gland was slightly enlarged.

On June 16, 11 days after inoculation, there was a firm flat tumour $3\frac{1}{2}$ in. by $2\frac{1}{2}$ in., the skin over the central part of which had broken down exposing yellow caseo-necrotic material; the left prescapular gland measured a little over 3 in. in length.

On June 26, 3 weeks after inoculation, the tumour measured $4\frac{1}{2}$ in. by 3 in. in area and about 1 in. in thickness; in the upper part there was a deep ulcer

about half-an-inch in diameter; the prescapular gland measured $3\frac{1}{2}$ in. in length and a prepectoral gland was the size of a pea. The general condition of the animal remained good.

On July 6, 1906, 31 days after inoculation, the respirations were noticed to be slightly increased in frequency and the calf appeared to be losing flesh and was backward in its growth.

The tumour increased a little further in size and the ulcer gradually enlarged, a cavity being formed in the centre of the tumour.

The general condition of the animal remained

much about the same for a long time, the respirations being only slightly more frequent than normal.

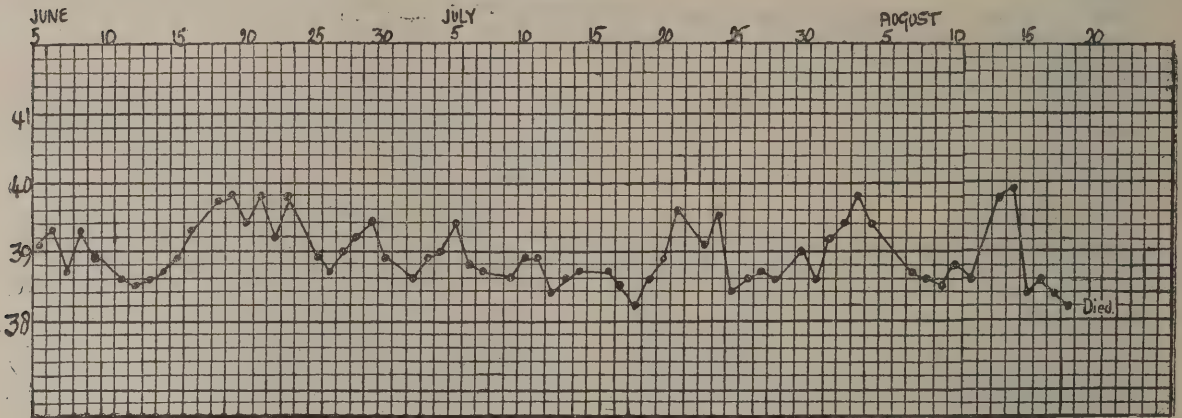
During the last week of life the respiration increased a little in frequency and became distinctly laboured. The calf was found dead on August 20, 1906.

Weights.

			cwt.	qrs.	lbs.
June 5, 1906 ...	...	...	0	2	8
June 25, 1906 ...	...	...	0	2	11
August 20, 1906 ...	...	...	0	2	4

Loss in weight on the initial weight.—4 lbs

Temperature.



POST-MORTEM EXAMINATION.

Condition.—Moderate.

Local Lesion.—On the left side of the neck there was a somewhat flattened tumour measuring $5\frac{1}{2}$ in. in length, 3 in. in breadth and about 1 in. in greatest thickness. It showed on the external surface a deep ulcer, 3 in. by 1 in., which communicated with a flat space in the centre of the tumour; on section this space was found to be surrounded by a comparatively thin layer of dense yellow caseo-necrotic tissue which was adherent to the skin and slightly infiltrated the muscles; the internal wall, where exposed to the air through the ulcer, was covered with a brownish black layer of dried discharge; elsewhere the space was lined with soft rather foul-smelling caseo-pus.

Left Prescapular Gland.—The left prescapular gland weighed a little over 2 ozs., and measured 3 in. by $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. and on section was composed throughout of dense homogeneous yellow caseated tissue showing no sign of calcification; the capsule of the gland was slightly thickened.

The Right Prescapular Gland was normal.

Prepectoral Glands.—On the left side the rounded prepectoral, the size of a marble, was yellow and caseous around the margins, firm and translucent in the centre; the reniform gland, the size of a large bean, showed a large caseous patch at one extremity, elsewhere a pea-sized caseous nodule and several discrete caseous tubercles. On the right side the glands were normal.

Cervical Glands.—A lower cervical gland on the left side, the size of a thrush's egg, resembled on section the left prescapular; the left upper cervical gland contained two hempseed-sized caseous tubercles; other cervical glands on the left side were normal. On the right side two in the middle of the neck were enlarged to the size of kidney beans; one was three-quarters caseous; the other contained a pea-sized caseous nodule.

A gland just within the entrance to the thorax on the left side, the size of a pigeon's egg, was dense yellow and caseous practically throughout.

Thorax.

Lungs.—The lungs collapsed only partially and were congested and mottled with dark red angular patches of consolidation, largest and most numerous in the anterior lobes.

The lung parenchyma contained numerous evenly distributed nodules ranging in size from 2 mm. up to 1 cm. in diameter; these on section were yellow and caseous in the centre, grey around the margins, the larger ones having a lobular outline; between the nodules there were a few scattered tubercles with caseous centres up to 1 mm. in diameter.

The subpleural nodules projected beyond the surface and a few on the dorsal mediastinal surface were mushroomed.

On the ventral surface of the caudal lobes along the lines of the interlobular septa there were several clusters of flattened grey tubercles with yellow centres bound together by reddish connective tissue.

The Bronchial and Mediastinal Glands were moderately enlarged and together weighed 5 ozs.; on section the cortices were composed throughout of dense yellow caseated tissue showing here and there foci of congestion and in one or two of the glands minute islets of grey translucent tissue.

Pleura.—On the pleural surface of the diaphragm there was a moderate number of flattened nodules, the largest 2 mm., with yellow caseous centres; they occurred chiefly in small groups. On the caval fold of pleura there were several patches of firm reddish vegetations and a few discrete tubercles. Along the margins of the ribs there were continuous rows of reddish vegetations containing small tubercles.

Larynx.—Normal.

Trachea.—The mucous membrane in the anterior part showed a few congested caseous foci.

Abdomen.

Omentum.—The lymphatic fringes on the ventral surface of the omentum were congested and slightly hypertrophied and contained scattered reddish tubercles, the largest the size of a millet seed, some with yellow centres.

Parietal Peritoneum.—On the peritoneum near the margin of the ribs on the right side there was a lenticular nodule 5 mm. in diameter. The peritoneum covering the tendon of the diaphragm showed two patches of soft pinkish connective tissue and a number of small tubercles running parallel to the fibres of the tendon.

Spleen.—The spleen weighed 4 ozs. and showed on section a moderate number of firm yellow caseous nodules with narrow grey margins ranging in size

from a hemp seed to a small pea (4 mm.); the subcapsular nodules caused slight projections and the capsule over them was slightly thickened and adherent.

Liver.—The liver showed on the surface moderately numerous nodules; a few of these were raised above the surface and had filmy grey margins, the largest measuring about 5 mm. in diameter; other nodules projected only slightly or were dimly seen through the capsule; on section the nodules were yellow and caseous and had narrow grey margins; similar nodules were evenly distributed throughout the substance.

Gall Bladder.—Normal.

Portal Glands.—The portal glands were enlarged, indurated and showed on section irregular yellow caseous patches surrounded by translucent fibroid tissue.

Kidneys.—The left kidney showed in the cortex a considerable number of pale grey foci, the largest the size of a pin's head; there were similar foci in the right kidney and also one or two larger ones with slightly opaque centres.

The Right Suprarenal Body showed in the cortex a yellow caseous nodule the size of a hemp seed.

Left Suprarenal Body.—Normal.

Alimentary Tract.

Tongue, Pharynx, and Left Tonsil.—Normal.

The Right Tonsil contained one softened caseous nodule.

Small Intestine.—In the lower part of the ileum there were numerous caseous nodules ranging up to a hemp seed in size, the majority of which were ulcerated; the rest of the small intestine appeared normal.

Large Intestine.—Several lymphoid follicles in the large intestine were enlarged and ulcerated, and showed in the centre some soft caseous substance.

Gastric Glands.—Two or three gastric glands were enlarged and composed of translucent grey tissue mottled with yellow caseous patches; others contained discrete caseous nodules.

Mesenteric Glands.—The glands at each extremity

of the mesentery were slightly enlarged and showed their cortices extensively replaced by dense yellow caseous areas; other mesenteric glands contained discrete caseating nodules of various sizes.

Various Lymphatic Glands.

The Celiac Glands were enlarged and showed on section yellow caseous areas surrounded by translucent fibroid tissue.

Lumbar Glands.—One lumbar gland showed the whole of the cortex composed of grey caseating tissue; the rest contained discrete caseating nodules.

The Left Prececal Gland contained a hemp seed sized caseous nodule; the right was normal.

Pudic Glands.—One contained a pea-sized caseous nodule; the other was normal.

Each Popliteal Gland contained a hemp seed sized caseous nodule.

The Right Gluteal, the Left Ischiatic, the Left Iliac and an Ilio-Sacral Gland each contained two or three firm yellow caseous nodules, the largest 4 mm. in diameter.

The Right Iliac, the Left Gluteal and the Right Ischiatic Glands were normal.

Axillary Glands.—Normal.

The Left Submaxillary Gland showed a yellow caseous mass replacing nearly half the substance, and a group of small caseous tubercles.

The Right Submaxillary Gland was normal.

The Right Retro-Pharyngeal Gland was enlarged and its substance extensively replaced by large yellow caseous nodules.

The Left Retro-Pharyngeal Gland contained three caseous nodules, the largest the size of a pea.

Haemolymph Glands.—Here and there a hæmolymph gland was seen to contain a caseous nodule.

Eyes.—Normal.

Testicles.—Normal.

CALF 422. Control.

Subcutaneous inoculation of culture derived from the original material of Virus B. XXVI. (Bronchial glands).

Dose—50 milligrammes.

Date—June 5, 1906.

Weight—2 qrs. 19 lbs.

Died—July 19, 1906. [44 days after inoculation.]

Clinical History.

The calf was inoculated subcutaneously on the left side of the neck on June 5, 1906.

On the next day there was a slight subcutaneous thickening $1\frac{1}{2}$ in. in diameter. On the fourth day there was a slightly raised thickening measuring 3 in. by $1\frac{1}{4}$ in. in superficial area.

On June 16, 11 days after inoculation, there was a large infiltrating tumour moulded to and partly surrounding a large prescapular gland.

On June 26, three weeks after inoculation, the tumour measured 6 in. by 4 in. and between 1 in. and 2 in. thick; no change had as yet been observed in the general health.

On July 4, 1906, 31 days after inoculation, the respirations were observed to be a little increased in frequency.

On July 6, 1906, the respirations were definitely increased and the calf was obviously ill (rough coat, depression, etc.). It gradually got worse and lost flesh and strength. The respirations became only moderately increased in frequency and were never laboured.

The appetite remained good until towards the end of the experiment.

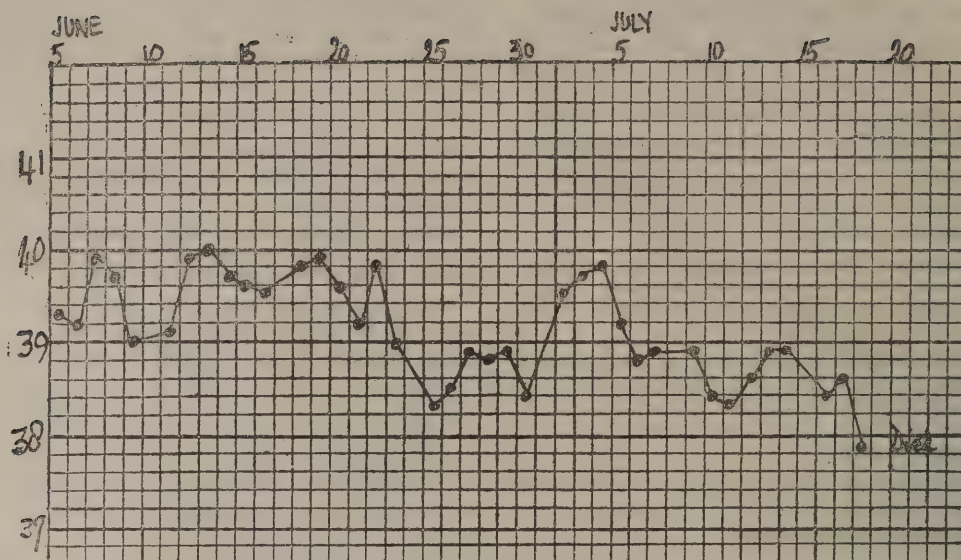
Weights.

There was a gain in weight of 1 lb. in the first 20 days and loss of 13 lbs. in the last 24.

	qrs.	lbs.
June 5, 1906	...	2 19
June 25, 1906	...	2 20
July 19, 1906	...	2 7

Loss in weight.—12 lbs.

Temperature.



POST-MORTEM EXAMINATION.

Condition.—Poor.

Local lesion.—On the left side of the neck there was a somewhat flattened tumour measuring 6 in. by 4 in., by $1\frac{3}{4}$ in. in greatest thickness; in the centre of the external surface there was a deep irregular ulcer, $1\frac{1}{2}$ in. in greatest diameter, which communicated with a flattened space in the middle of the tumour lined with soft brownish necrotic material; on section the tumour was found to be composed of the usual dense yellow caseo-necrotic tissue, adherent to the skin and infiltrating the muscles; the intact skin was congested and a little thickened and beset with small yellow tubercles.

Left Prescapular Gland.—The left prescapular gland weighed 4 ozs., and measured $3\frac{1}{2}$ in. by $2\frac{1}{2}$ in. by $1\frac{3}{4}$ in.; on section the greater part of the cortex was composed of dense pinkish yellow caseous tissue whilst the rest was closely beset with caseous tubercles; the capsule of the gland was a little thickened.

Right Prescapular Gland.—The right prescapular gland was not enlarged; it contained a number of caseous nodules, occurring chiefly in groups.

Prepectoral Glands.—On the left side the spherical prepectoral gland was the size of a large pea and showed a few caseous foci in the cortex; the reniform gland was enlarged, one part of the cortex was firmer than normal and speckled with caseous points, in the rest of the gland there were a few discrete caseous nodules; another gland near the latter was slightly enlarged and showed a few early caseous foci.

Right Prepectoral Glands.—The right prepectoral glands contained discrete caseous nodules, the largest the size of a hemp-seed.

Cervical Glands.—On the left side one, a few inches from the thorax, 1 cm. in greatest diameter, was indurated and showed yellow caseous nodules closely set around the cortex; a gland, just within the entrance to the thorax, the size of a pheasant's egg, was composed practically throughout of dense yellow caseated tissue; the upper cervical gland contained three caseous nodules. The glands on the right side were slightly enlarged; each contained a few caseous nodules, similar to those in the peripheral glands.

Thorax.

Lungs.—The lungs were enlarged and mottled on the surface with irregular dark red patches of consolidation; these patches were most numerous in the left lung and caused almost complete consolidation of the ventral half of the cephalic and the antero-ventral portion of the caudal lobes.

The parenchyma of the lung was closely and evenly beset with yellow caseous tubercles, ranging in size from a pin's head to that of a hemp-seed; the sub-

pleural tubercles, except on the dorsal surface of the caudal lobes, caused projections from the surface. Scattered about the substance of each of the lobes were solid caseating masses occupying a part or the whole of the lobule.

Thoracic Glands.—The bronchial and mediastinal glands were enlarged and weighed together 4 ozs.; on section the cortices were composed throughout of a dense grey translucent tissue closely beset with small irregular yellow caseous patches (these glands resembled the portal and coeliac glands, but were perhaps a little more advanced in caseation).

A small gland in the ventral mediastinal pleura near the apex of the heart, and the ventral mediastinal glands, contained yellow caseous nodules similar to those in the peripheral lymphatic glands.

Pleura.—The fringes along the margins of some of the ribs were congested and contained small grey tubercles occurring chiefly in clusters. The pleura covering the diaphragm showed a few groups of small tubercles.

Heart and Pericardium.—Normal.

Larynx and Trachea.—Normal.

Abdomen.

Omentum.—The omentum showed on its inferior surface about half-a-dozen lenticular nodules, yellow in the centre, ranging in size from a pin's head to a wheat grain.

Peritoneum.—Normal.

Spleen.—The spleen, enlarged, weighed about $6\frac{1}{2}$ ozs.; there were no tubercles on the surface; the pulp contained moderately numerous firm yellow caseous nodules ranging in size from a millet to a hemp seed.

Liver.—The liver was normal in general appearance; on the surface sparsely scattered caseating tubercles were seen, varying in size from a mere point up to that of a millet seed; the larger tubercles were slightly raised above the surface and some had filmy grey margins; on section small caseous tubercles up to a pin head in size were very sparsely scattered throughout the substance.

Gall-bladder.—Normal.

Portal Glands.—The portal glands were considerably enlarged and showed on section the cortices closely beset with irregular yellow caseous nodules embedded in a firm grey translucent matrix.

Kidneys.—Each kidney showed in the cortex sparsely scattered caseous tubercles, with grey margins, the largest a little larger than a millet seed; the larger ones were elongated in a radial direction.

Suprarenal bodies.—The right contained one opaque yellow miliary tubercle; the left was normal.

Alimentary Tract.

Tonsils.—The left tonsil contained one caseous nodule; none seen in the right.

Tongue, Pharynx.—Normal.

Thymus.—The thymus contained a millet seed-sized caseous tubercle.

Small Intestine.—In the long Peyer's patch there were fairly numerous caseous tubercles, the largest the size of a millet seed; in the rest of the intestine tubercles were very sparsely scattered.

Large Intestine.—Normal.

The Mesenteric Glands contained discrete yellow caseous nodules irregular in outline, similar to those in the iliac glands; in several these were aggregated together to form larger nodules; the gastric, ileocolic and colic glands resembled the mesenteric.

Various Lymphatic Glands.

The Submaxillary, Retro-pharyngeal, Parotid and Mastoid Glands were slightly enlarged and contained numerous irregular firm yellow caseous nodules up to 4 mm. in diameter.

The Right Axillary Gland contained several caseous nodules; in the left there was only one.

Celiac Glands.—One celiac gland was very large and on section resembled the portal glands; a smaller gland showed yellow caseous nodules becoming confluent.

The Renal and Lumbar Glands were enlarged and closely beset with yellow caseous nodules.

The Iliac, Ilio-Sacral, Preaural, Pudic, Popliteal and Gluteal Glands showed a varying number of discrete yellow caseous nodules, irregular in outline, ranging up to 2 and 3 mm. in diameter.

Ischiatic Glands.—Normal.

Eyes.—Normal.

Testicles.—Normal.

Microscopical Examination.

(Smear Preparation):—

Tubercle from Small Intestine.—Numerous tubercle bacilli.

CALF 474. Control.

Subcutaneous Inoculation on the left side of the neck of culture derived from Virus B. XXVI. (Bronchial gland).

Dose—50 milligrammes.

Date—July 26, 1906.

Weight at Inoculation—1 cwt. 1 qr. 23 lbs. [Age about 17 weeks.]

Killed when well—October 26, 1906. [92 days after inoculation.]

Clinical Notes.

The calf was inoculated subcutaneously on the left side of the neck on July 26, 1906. Twenty-four hours after the inoculation a well-defined local thickening 1 in. in diameter could be felt.

On the 13th day there was a hard infiltrating deep-seated local tumour, measuring about 6 in. by 4 in.; it was in close contact with a very large prescapular gland, but the latter was not adherent to it. The animal was unwell, its temperature was raised, and its coat rough.

On the 28th day the tumour was firm and prominent, deeply infiltrating the muscles, particularly in the lower part. The prescapular gland was very large, 5 in. in length, and there was oedema around the lower part of the gland and the dewlap. The coat was rough, otherwise the general condition of the calf was moderately good. The temperature was almost normal, 39.1°C.

POST-MORTEM EXAMINATION.

Local lesion.—At the seat of inoculation on the left side of the neck in the subcutaneous tissue there was a prominent irregular tumour, measuring 7 in. by 4½ in. by 3½ in. and weighing with skin and muscle 1 lb. 9 ozs. It was adherent to and infiltrated both skin and muscle and was connected with the prescapular gland by a firm cord ½ in. in diameter. On section the tumour consisted of dense caseo-necrotic substance, honeycombed in one part and tending to form a cavity. The dependent portion of the tumour was divided into two limbs, one adherent to the skin, the other passing beneath and partly within the muscle.

Left Prescapular Gland.—The left prescapular gland weighed 2½ ozs. and measured 3 in. by 2 in. by 1½ in. On section the gland tissue was almost entirely replaced by firm caseo-necrotic substance and there remained a triangular area of the cortex which contained discrete caseous streaks and foci.

On the 50th day the tumour was roughly pear shaped, and slightly softened; it measured 5½ in. by 3½ in. Between it and the large prescapular gland (4 in. by 2 in.) was a mass of infiltrated tissue. The calf was thinner.

No further changes of importance took place in the local conditions; the general condition of the calf improved, and it gained considerably in weight. It was killed 92 days after inoculation.

Throughout the experiment the temperature was definitely above the normal, but was never high, the maximum being 39.9°C.

Weights.

	cwt. qr. lbs.			
July 26, 1906	...	1	1	23 Inoculated.
October 26, 1906	...	1	3	7 Killed.

Total gain of weight during experiment.—1 qr. 12 lbs.

Average rate of gain per week.—3 lbs.

Left Prepectoral Glands.—The prepectoral glands on the left side were slightly enlarged and firm and contained in the cortices caseous streaks and foci forming a fine network.

Left Cervical Glands.—One gland was enlarged and almost caseous throughout; a second showed a fine caseous network in part of the cortex. A mid-cervical gland the size of a thrush's egg consisted throughout of dense caseo-necrotic substance with small hæmorrhages; two other glands showed discrete caseous streaks. About half of the superior cervical gland was filled with a caseous network.

Thorax.

Heart, Pleura, Pericardium and Diaphragm.—Normal.

Lungs.—The lungs were a little voluminous, but were crepitant. The anterior lobes were oedematous. The surfaces of both lungs were mottled by moderately numerous discrete dark areas, which varied in

size up to 1 cm. in greatest dimension. They were irregular but roughly quadrilateral in shape, and on section were composed of grey tissue with a caseous network surrounded by a dark congested area.

Mediastinal Glands.—The posterior dorsal mediastinal gland measured $4\frac{3}{4}$ in. in length and $1\frac{1}{4}$ in. at its widest part. On section the outer part of the cortex was firm and studded with yellow miliary tubercles and irregular caseous foci; the rest of the gland was congested. The other mediastinal glands presented a similar appearance.

Bronchial Glands.—The bronchial glands were somewhat enlarged and showed the same appearance of discrete caseous tubercles in fine grey cortical tissue.

Abdomen.

Omentum.—The omentum contained two rounded bodies the size of small peas which were made up of translucent capsules filled with caseous substance.

Peritoneum.—Normal.

Spleen.—The spleen weighed 5 ozs. There were no tubercles on the surface. On section it contained sparsely scattered caseous miliary tubercles with grey margins and uniform in size.

Liver.—In the liver, visible from the external surface, there were twelve tubercles varying from 5 mm. up to 2.5 mm. in diameter. These on section consisted of caseous gritty substance in a thin grey capsule. Section through the liver revealed in the substance only two more small tubercles.

Gall-bladder.—Normal.

Portal Glands.—The portal glands showed a moderate number of irregular discrete caseous tubercles in the cortices not larger than rape seed.

In one there was a nodule 1 cm. in diameter, fibrous with a close caseous network.

Kidneys.—Each kidney showed on the surface two grey tubercles. On section there was in the right a translucent tubercle with a minute opaque centre.

Suprarenal Bodies.—Normal.

The Renal Lymphatic Glands on both sides contained scattered firm grey tubercles with caseous centres, up to a hemp seed in size.

Stomachs and Gastric Glands.—Normal.

Intestines.—Normal.

Mesenteric Glands.—The majority of the mesenteric glands were normal. In each of two there was a small caseous nodule with a grey margin; in three others there was a caseous tubercle the size of a wheat grain, and a few showed opaque foci in the superficial part of the cortices.

Tongue, Pharynx, Larynx, Tonsils, and Trachea.—Normal.

Various Lymphatic Glands.

Right Reniform Prepectoral and Right Axillary.—Normal.

The Right Rounded Prepectoral, Left Axillary, Right Iliac, Left Submaxillary, Right and Left Parotid, Right and Left Gluteal, Right and Left Preaural, Left Popliteal, Right and Left Retro-Pharyngeal showed a few discrete caseous tubercles, varying in number from one to several in each and in size up to a hemp seed.

A Coeliac and a Lumbar Gland showed a moderate number of discrete caseous tubercles.

Left Iliac, Right Submaxillary, other Coeliac and Lumbar Glands, and the Ischiatic Glands.—Normal.

CALF 476. Control.

Subcutaneous inoculation on the left side of the neck of culture derived from Virus B. XXVI. (Bronchial glands).

Dose—50 milligrammes.

Date—July 26, 1906.

Weight at Inoculation—1 cwt. 2 qrs. 10 lbs. [Age about 19 weeks.]

Died—September 21, 1906. [57 days after inoculation.]

Clinical Notes.

The calf was inoculated subcutaneously on the left side of the neck on July 26, 1906.

Twenty-four hours after the inoculation a slight local thickening could be felt, and the adjacent prescapular gland was slightly enlarged.

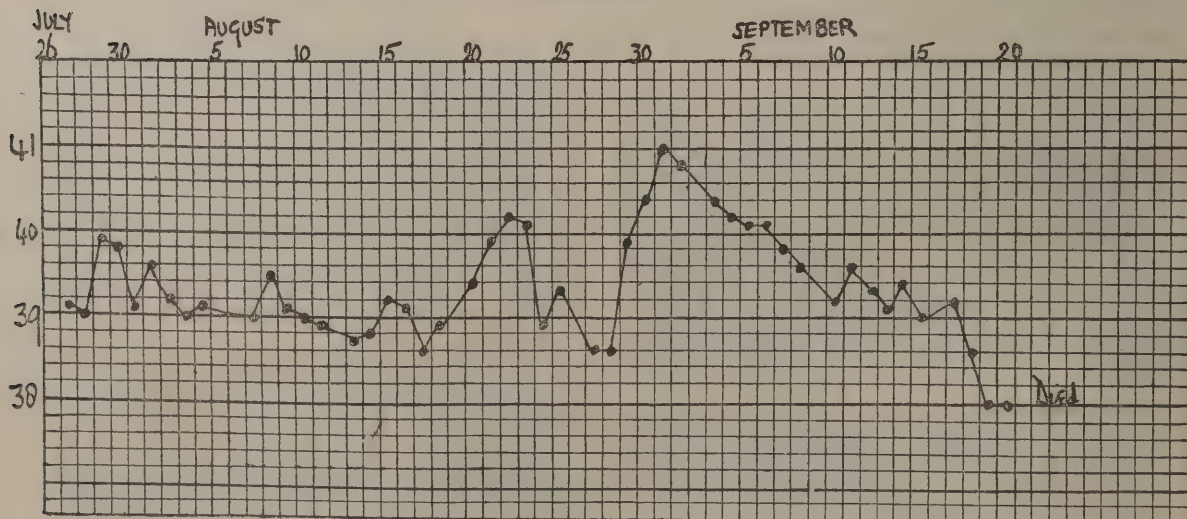
On the 13th day there was a firm square tumour, 5 in. by $4\frac{1}{2}$ in., at the seat of inoculation; the prescapular gland was enlarged, 5 in. long. Calf in good condition; temperature a little raised, 39.5°C .

On the 23rd day the animal was unwell; its coat was staring, and it seemed to be losing flesh.

On the 28th day it was distinctly thinner; the coat was rough and the appetite poor. There was no obvious increase in the rate of respiration; the temperature was high, 40.1°C . The local tumour now measured 8 in. by 5 in. by about 2 in. in thickness, and the prescapular gland was 6 in. in length.

On the 50th day the breathing was difficult, and there was slight cough; the temperature, which reached 41.0°C . on the 36th day, had since been steadily falling, and was now 39.4°C . The calf rapidly became worse; on the 56th day the temperature had fallen to 38.0°C ., and on the following day the calf died.

Temperature.



Weights.

	...	1	2	10	Inoculated.
July 26, 1906		1	2	10	Inoculated.
September 21, 1906		1	0	17	Died.

Total loss of weight during experiment.—1 qr. 21 lbs.

Average rate of loss per week.—6 lbs.

POST-MORTEM EXAMINATION.

Carcass very emaciated.

Local lesion.—On the left side of the neck there was a very large, pendulous, well-defined tumour measuring 8½ in. by 6½ in., by about 3½ in. in greatest thickness, and weighing 3½ lbs. The skin covering the central part of the tumour was necrosed and of a brownish black colour and showed several irregular ulcerous openings discharging ill-formed pus. On section the external portion was composed of juicy homogeneous caseo-necrotic substance, of a salmon-pink colour; the deeper portion was firmer, yellower and intersected by connective tissue trabeculae. In the centre of the external portion there was an elongated lenticular cavity communicating externally and containing a small quantity of yellowish-brown foul-smelling caseo-pus; the caseous substance forming the anterior wall of this cavity was friable and highly necrotic. The skin around the periphery of the tumour was greatly thickened and composed throughout of soft congested caseo-necrotic substance.

Extending from the inferior extremity of the tumour to the inferior extremity of the prescapular gland were two thick cords, the largest 1 in. in diameter, composed of dense yellow caseated tissue; they terminated in a large caseous mass, divided into nodules by bands of fibrous tissue, which surrounded, and was intimately adherent to, the lower extremity of the prescapular gland. The muscles around this mass and the two cords were infiltrated with caseous tubercles running parallel to the muscle fibres.

The tissues around the lower part of the tumour and the nearest glands were thickened and oedematous.

Left Prescapular Gland.—The left prescapular gland measured 5 in. by 3 in. by 2½ in. and weighed 13 ozs.; on section it was composed throughout of dense pinkish yellow and yellow caseated tissue showing foci of congestion but none of calcification; the capsule was distinctly thickened.

Right Prescapular Gland.—The right prescapular gland was enlarged and very oedematous; it contained an irregular caseous mass, 1.5 cm. in diameter, and half-a-dozen pea-sized caseous nodules.

Prepectoral Glands.—On the left side the spherical prepectoral gland was the size of a walnut and resembled on section the left prescapular gland; the reniform gland, a little over 2 in. in length, showed the cortex composed of firm grey tissue closely infiltrated with a yellow caseous network. The right prepectoral glands were enlarged and oedematous, but were not otherwise abnormal.

Cervical Glands.—Near the left mastoid process there were three large glands, the largest measuring 3 in. by 1½ in. by 1 in., the smallest 1½ in. in greatest diameter; the former was caseous throughout and resembled the prescapular; the other two were caseous almost throughout and in less advanced stage than the prescapular. In the middle of the neck on the left side there was a gland, the size of a thrush's egg, which showed the greater part of the substance dense and caseous. Nearer the thorax there was a smaller gland, part of which was firm and caseating.

On the right side the upper cervical gland contained two caseous nodules, the largest the size of a hempseed; one in the middle of the neck contained a smaller caseous nodule.

Thorax.

Lungs.—On opening the thorax the lungs collapsed only partially. The ventral flap of the left cephalic lobe was adherent to the parietal pleura and there were also slight adhesions, easily torn through, between the right cephalic lobe and the chest wall, and between the contiguous surfaces of the different lobes of each lung.

The lobes on the right side were mottled with diffuse dark red areas of consolidation, the small middle lobe being almost entirely airless. In the left lung there were similar areas of consolidation but these were more isolated except in the ventral flap of the cephalic lobe which was almost quite solid.

The surfaces of the lungs, except the dorsal surfaces of the caudal lobes, were studded with slightly raised yellow nodules, flattened on the surface, a few in the cephalic lobes being slightly mushroomed; they varied in size up to about 8 mm., were irregular in outline and were here and there aggregated together to form larger masses; on section they were firm and almost uniformly yellow and caseous; besides the larger nodules there were numerous grey tubercles with caseous centres ranging from a mere speck up to a millimetre or more in diameter; on section similar nodules and tubercles were distributed throughout the lung parenchyma; they were least numerous in the extreme posterior portions of the caudal lobes.

Thoracic Glands.—The bronchial and mediastinal glands were considerably enlarged and formed a continuous chain along the dorsal mediastinum; they weighed together 11 ozs., the caudal gland measuring 5 in. in length; on section their cortices were firm, yellow and with the exception of minute islets of congested grey tissue caseous throughout. The peribronchial glands were similarly affected.

Pleura.—The lymphatic fringes along the margins of the ribs were slightly hypertrophied and congested in places and contained a few scattered flattened caseous nodules ranging from 2 to 5 mm. in diameter.

There was similar hypertrophy of the fringes on the pleural surface of the diaphragm, chiefly around the margins of the tendon and along the line of reflexion of the caval fold of pleura; there were also a few flattened caseous nodules, up to 5 mm. in diameter.

Trachea.—The mucous membrane of the trachea near the larynx showed a slightly raised ulcerated caseous nodule.

Abdomen.

Omentum.—On the inferior surface of the omentum there were about half-a-dozen loosely attached lenticular nodules, the largest about 8 mm. in diameter; they were very dense, yellowish in the centre and two were deeply hæmorrhagic.

Peritoneum.—On one of the vesical folds of peritoneum there was a similar pea-sized nodule attached by a long pedicle.

Spleen.—The spleen was not apparently enlarged, and weighed 8 ozs.; on section there were moderately numerous firm spherical yellow caseous nodules ranging from 2 to 5 mm. in diameter.

Liver.—The liver showed on the surface under the capsule moderately numerous nodules ranging in size from about 1 up to 6 mm. in diameter; the larger ones projected slightly from the surface but were not mushroomed. On section similar nodules were evenly distributed throughout the substance; they were firm, yellow and homogeneous. Besides the larger nodules the substance contained numerous minute greyish white tubercles. On the dorsal surface of the liver, lying in a depression in the liver substance, was a large yellow mushroomed nodule measuring 1.5 cm. in diameter.

Gall-bladder.—Normal.

Portal Glands.—The portal glands were much enlarged, very oedematous and closely beset with firm caseating nodules in places confluent.

Kidneys.—The left kidney showed on the surface three grey miliary tubercles with opaque centres and two yellow caseous nodules, with narrow grey margins, the size of hempseeds; in the depth of the cortex one hempseed sized nodule was seen; the cortex also contained numerous greyish white translucent foci, ? early tubercles.

The right kidney showed on the surface about a dozen caseous nodules ranging in size from a millet seed to a pea; the larger ones were elongated in a radial direction; there were also numerous minute grey foci as in the left kidney.

Suprarenal bodies.—The right suprarenal showed in the cortex two whitish pinhead-sized tubercles.

Alimentary Tract.

Tongue, Pharynx and Tonsils.—Normal.

Small Intestine.—Appeared normal.

Large Intestine.—Several of the follicles in the cæcum were enlarged and caseous and the mucous membrane over them was congested.

Mesenteric Glands.—The chain of mesenteric glands contained numerous firm caseous nodules varying in size from a pea to that of a broad bean.

Colic Glands.—Several showed caseating nodules.

Eyes and Testicles.—Normal.

Various Lymphatic Glands.

Celiac Glands.—Enlarged, indurated and advanced in caseation.

Lumbar Glands.—Slightly enlarged, contained several large caseating nodules, some aggregated together.

Ilio-Sacral Glands.—One contained a caseous nodule 5 mm. in diameter.

Iliac Glands.—The right contained six firm yellow caseous nodules, the largest 6 to 7 mm. in diameter; the left contained four.

Precurural Glands.—There was one small nodule in the left and two groups of tubercles in the right.

Popliteal Glands.—The left contained one yellow nodule 8 mm. in diameter, the right three each about 4 mm. in diameter.

Gluteal and Pudic Glands.—There were three caseous nodules in the right gluteal, one in the left, and several large ones in the pudic glands.

Submaxillary Glands.—The left contained three large caseating nodules; the right two groups of smaller nodules.

Pharyngeal Glands.—Each contained numerous caseous nodules up to 8 mm.

Parotid Glands.—There was one small nodule in the left; the right was normal.

Axillary Glands.—The left was enlarged and showed more than half its cortex in a state of early caseation; the right was normal.

**Report (Submitted to the Commission in
1906) on the Stability of Virulence of
Tubercle Bacilli in the Living Animal.**

BY

DR. L. COBBETT.

NOTE.—Graphic Charts, illustrating the experiments dealt with in the Report, are included with others in Volume VII of the Appendix.

REPORT ON THE STABILITY OF VIRULENCE OF TUBERCLE BACILLI IN THE LIVING ANIMAL.

Submitted to the Commission in 1906.

PART I.

It has already been stated that the tubercle bacilli obtained from man and investigated at Blythwood Farm are, with the exception of a virus derived from a case of lupus, divisible into two groups according to their virulence for various animals. Both are highly virulent for the guinea-pig and monkey. One, which we call Group I., is highly virulent also for the ox, goat, pig, and rabbit; while the other, which we call Group II., and which is the common bacillus of human tuberculosis, possesses only a very low degree of virulence for these animals.

Viruses with an intermediate degree of virulence for the animals last mentioned have not been found, but one, namely H. 49. "T.C.", and perhaps also H. 20. "F.L.", have possessed a virulence when first tested which was not quite up to the standard of Group I. It is significant that the former was the only virus of this group which we obtained from a young adult. All the rest were from small children.

It cannot be doubted that the two kinds of tubercle bacilli which constitute our Groups I. and II., while sharply differing in their comparative virulence, are nevertheless closely related, and must have had a common origin in the past; and it is of great practical importance for the purpose of our investigation to enquire whether these two types have now become fixed and immutable, or whether it is possible under suitable conditions to convert the one into the other. This report deals with the experimental evidence of the possibility of raising the virulence for the ox and rabbit of strains of tubercle bacilli of human origin which have but slight virulence for these animals.

Many strains belonging to Group II. have been passed from calf to calf, or from one animal to another of another kind, without any appreciable modification in the virulence. For example, H. 8. "S.C." and H. 12. "H.N." The evidence of this is

contained partly in the general tables of the Appendix to the 2nd Interim Report, Vol. II., and in the second part of this Report will be found the more important of these modification experiments which have had a negative result. In the first part will be collected together the details of those experiments in which the virulence of the strain used has undergone a definite change.

In all of these latter experiments but one the strain of tubercle bacilli was at the start feebly virulent for calves and rabbits, and was, in fact, an ordinary example of a strain of Group II., and it became highly virulent for these animals before the end. These experiments which gave positive modification results were four in number, namely H. 16. "J.H.", H. 17. "Sp. B.", H. 13. "A.D.", and H. 21. "G.B."

In another case, the strain of bacilli known as H. 49. "T.C." was at the start only slightly less virulent for calves and rabbits than typical members of our Group I.; and it recovered full virulence for these animals after passing through a single calf. In still another case the strain known as H. 20. "F.L." probably underwent a similar modification (see Appendix to 2nd Interim Report, Vol. II, p. 489).

These instances of modification will be described in detail. The time, however, has not come to draw any final conclusions from them. Their interpretation must remain in suspense. They may be true instances of a conversion of a virus of Group II. (*Typus humanus* of the Germans) into a virus of Group I. (*Typus bovinus*), or they may be susceptible of some other interpretation. The question must continue to be investigated and judgment deferred until further evidence is available. In the meantime the facts already ascertained will be stated so that the reader may be in a position to review the evidence, as far as it goes, for himself.

MODIFICATION OF VIRULENCE OF THE VIRUS H. 16. "J.H."

The tuberculous material which formed the starting point of this experiment was obtained from a man, J.H., who was operated on for a tuberculous knee joint in 1903. There was no pulmonary disease, and the man, except for his knee, was in good health.

The tuberculous material received at Blythwood Farm, consisting of a quantity of gelatinous synovial membrane, was made into an emulsion with normal salt solution. This emulsion was estimated to contain 400 tubercle bacilli per cubic centimetre. Two calves, Nos. 155 and 157, were subcutaneously injected on the side of the neck on 18th June, 1903, each receiving 25 cc. of the emulsion, and therefore approximately 10,000 tubercle bacilli. Subsequent experience has shown that this dose, even if it consists of bacilli of Group I., is not sufficient to produce with certainty general progressive tuberculosis. (See table of tissue emulsions into calves, Appendix to 2nd Interim Report, Vol. II, p. 1035.)

Calf 155 was killed 54 days after injection. It was at that time in good health and had grown well. At the seat of injection was a small fibrous tumour infiltrated with caseous points. The prescapular and prepectoral glands on the same side contained caseating nodules. Four minute grey tubercles were found in the lungs similar to those often seen since in calves injected with a virus of Group II., and one doubtful speck was seen on the surface of the liver. In none of these little foci were tubercle bacilli found. The rest of the animal was normal.*

An emulsion was made from the local lesion and prescapular gland of this calf, and 20 cc. were injected under the skin of the neck of Calf 229 on 11th August,

1903. The number of tubercle bacilli estimated in the dose was 712,800. The animal was killed 91 days after injection when in good health. There was a small fibro-calcareous tumour at the seat of injection, and the prescapular and prepectoral glands on the same side contained a few calcareous grains.

Calf 157 was killed 67 days after injection. Like its fellow it had grown well. There was a small fibrous tumour with yellow calcareous grains at the seat of injection, and some calcareous nodules in the prescapular and prepectoral glands of the same side. There was also a small calcareous focus in the right bronchial gland. The rest of the animal was normal. An emulsion was made of the prescapular and prepectoral glands, 10 cc. of which, estimated to contain 3,000,000 tubercle bacilli, were injected subcutaneously on the left side of the neck into Calf 187.

This animal was killed 81 days after injection, and again the lesions were found to be limited to the seat of inoculation and the nearest lymphatic glands.

Thus so far four calves had been inoculated, and minimal lesions only had been produced. The doses, however, had contained only moderate numbers of tubercle bacilli. It will nevertheless be seen that after the virulence of the virus had become modified, similar doses were quite sufficient to produce general tuberculosis, which in all the calves but that which received the smallest dose was severe. Thus there is evidence that at this stage we were dealing with a virus which was not virulent for the ox species. It was not tested at this stage on rabbits

An emulsion having been made of the local lesion

* Full post-mortem notes of this and other calves mentioned in the Report will be found in Vol. II of the Appendix to the 2nd Interim Report.

and prescapular glands of Calf 187, 25 cc., estimated to contain nearly 11,000,000 tubercle bacilli, were injected subcutaneously into the left side of the neck of Calf 273. The dose was the largest hitherto given with this virus.

The animal remained in good health, and was killed 89 days after the inoculation, having gained 61 lbs. At the seat of inoculation a solid caseo-necrotic tumour was found, containing a small central cavity and infiltrating both skin and subjacent muscle. The left prescapular and prepectoral glands were much enlarged, and were caseous throughout. The thoracic glands were enlarged and firm, and were closely studded with little caseo-calcareous nodules. The lungs were extensively, but not severely affected, their surface was studded with tubercles, some of them $\frac{1}{8}$ in. in diameter, and similar tubercles were found scattered throughout their substance. The centres of these tubercles were found to be caseous. One nodule rather larger than the rest, and spherical in shape, proved to be a cyst containing softened greenish pultaceous matter. No tubercle bacilli were found in its contents. In the liver and spleen were a few rather large tubercles. The kidneys were normal. A few caseo-calcareous foci were found in the glands of the portal fissure, but the mesenteric and other lymphatic glands were normal, with the exception of the right superficial parotid, in which was a caseous focus the size of a large pin's head. The intestine was normal, except for a minute speck in one of the Peyer's patches, in which one tubercle bacillus was found.

This animal then was the first of this series to develop general tuberculosis, but the disease was not of the severest type.

An emulsion was made from the prescapular gland, and 20 cc., estimated to contain 3,000,000 tubercle bacilli, were injected subcutaneously into the right side of the neck of each of the two calves 337 and 355. It will be observed that the number of bacilli injected was approximately the same as that injected into Calf 187.

No. 337 was killed 80 days after the injection, never having been seriously ill, and having gained 2 qrs. 13 lbs. in weight. There was a large fluid tumour at the seat of inoculation, and caseo-necrotic nodules and calcareous foci in the prescapular and prepectoral glands. On the surface of the lungs was a small number of raised tubercles $\frac{1}{4}$ in. to $\frac{1}{8}$ in. in diameter, and a large number of smaller tubercles dark and translucent, only a few of which contained opaque centres. Similar little tubercles were scattered thickly throughout the organ. Two little tubercles were seen on the surface of the liver, and one in its interior. A moderate number of tubercles were seen in the spleen and a few in the kidneys, and some tubercles were found in the hepatic and mesenteric glands. This calf was rather more severely affected than 273.

No. 355, on the other hand, became seriously ill, and 43 days after the injection was killed when in an apparently dying condition.

At the seat of inoculation was a large solid infiltrating tumour. Very numerous miliary tubercles were found in all the organs. The thoracic glands were caseo-necrotic and tubercles were found in many other of the lymphatic glands of the body.

This, then, was a case of acute general tuberculosis, not perhaps of the severest type seen here, but nevertheless of considerable severity when the relatively small dose of 3,000,000 bacilli is taken into consideration.

An emulsion made of the prescapular gland of this animal was estimated to contain over 4,000,000 bacilli per cc. It was injected subcutaneously into four calves, in doses estimated to contain 10,000, 712,000, 3,000,000, and nearly 11,000,000 tubercle bacilli respectively, the first three repeating the doses injected into the calves already mentioned.

No. 281, which received the largest dose of bacilli, was killed when very ill 54 days after injection, having gained 24 lbs. in weight. It was found to have severe general miliary tuberculosis.

No. 317, which received 3,000,000 bacilli, was killed when ill 80 days after injection, having gained 20 lbs., and general miliary tuberculosis was found, slightly less severe than that in 281.

No. 343, which received 712,000 bacilli, was killed

68 days after injection when very ill. It had gained 11 lbs. It was found to have acute miliary tuberculosis more severe than in 317, and every lymphatic gland in its body was tuberculous. This was a very severe result considering the smallness of the dose.

No. 371, which received 10,000 bacilli, was killed 66 days after injection when apparently in good health and having gained 2 qrs. 4 lbs. A calcareous lesion was found at the seat of inoculation, and the nearest lymphatic gland was enlarged and caseo-necrotic. There was a small number of tubercles in the lungs, grey, with small caseous centres. Two small tubercles were found in the liver and two in the spleen.

There were some tubercles also in the thoracic, hepatic and one of the mesenteric glands. This animal was therefore distinctly more affected than the two original calves which received a similarly small dose.

At this stage of the experiment it was thought advisable to inject some adult bovine animals, in order to determine whether the virus had really reached the highest pitch of virulence for this species. All the calves were then dead, but a rabbit, No. 66, had also been injected with the emulsion used for the last four calves. It died of general tuberculosis after 85 days, and an emulsion rich in tubercle bacilli was made of some of its tuberculous lesions. This was injected into a heifer of nearly two years of age weighing over 5 cwt., and into a yearling bull weighing 3 cwt., in doses of 20 cc. estimated to contain over 157,000,000 bacilli.

The bull, 423A, was killed when very ill 42 days later. It was found to have an enormous solid tumour at the seat of inoculation, and severe miliary tuberculosis of all its organs and lymphatic glands.

The heifer, 245, proved to be more resistant. It was killed 209 days after injection when fairly well. It was found to have severe tuberculosis of lungs of the perlsucht type, and a slight amount of tuberculosis of the spleen and kidney. The liver was normal, except for some thickened bile ducts.

The animal was pregnant when injected, and gave birth to a calf 16 days before it was killed. The chorion was studded with little tubercles in which bacilli were found, and after the death of the heifer tubercle bacilli were found in scrapings from one of the cotyledons of the uterus.

The calf was killed 5 days after birth, and a few foci which contained tubercle bacilli were found in the hepatic glands.

SUMMARY OF THE ABOVE EXPERIMENTS WITH H. 16. "J.H."

The total duration of the experiment was eighteen months, during which the virus had passed through six generations of animals, namely five bovines and one rabbit. At the commencement it was practically non-virulent for bovines and quite incapable of setting up a fatal or progressive infection in them. At the termination it was fully as virulent for them, and for rabbits, as any of our Group I. strains. Moreover, there can, I think, be no doubt that the virulence increased gradually, and this can be clearly seen in the drawings which indicate the extent of the lesions, especially if Calves 187, 337, 335, and 317, which received approximate equal doses, be compared. (See Vol VII of the Appendix.)

CULTURES FROM THE PRECEDING ANIMALS.

Cultures were obtained from the original material through Guinea-pig 609, and from the third, fourth (two), fifth and sixth calves of the series, namely from 273, 337 and 355, 317 and 423A.

The first two of these cultures possessed the characters of growth of those strains which have a feeble virulence for bovine animals, the last had the dysgonic characters of growth characteristic of the strains which are highly virulent for these animals. The cultures from the fourth calf possessed intermediate characters of growth on artificial media, while that from the fifth calf approximated to that from the sixth.

Thus not only had a gradual change of virulence, but a gradual change of cultural characters also taken place in this strain of tubercle bacilli in its passage through these animals, and this had occurred within a period of a year and a half.

ESTIMATION OF THE VIRULENCE OF THE ABOVE-MENTIONED STRAINS OF CULTURE.

These strains, with the exception of that from 355, were each of them injected in 50 mg. doses into two calves. That from Calf 337 was injected in 10 mg. doses also.

The cultures were grown upon serum, and were three weeks old when injected. The total duration of artificial cultivation at the time of the injections was as follows: That from Guinea-pig 609, 14 months; that from Calf 273, 10 months; from Calf 337, 12 months; from Calf 317, 10 months; and from Bull 423A, 3 months.

The culture obtained from the guinea-pig injected with the human synovial membrane produced minimal lesions only, no tubercles being found beyond the nearest lymphatic glands.

That from Calf 273, the first to be affected with general tuberculosis, produced also minimal lesions in the two calves injected with it. In one of them there were also minute translucent tubercles in the lungs, but no significance can be attached to this fact. (See Vol. III of Appendix to 2nd Interim Report, Page 211.)

Rabbits also were injected at the same time as the calves, and these, too, developed minimal and non-progressive lesions.

It was surprising that this culture obtained from a calf which had general tuberculosis had little or no more virulence for the bovine species and rabbits than that obtained from the human synovial membrane; for the bacillus, when it existed in this calf, must have been virulent or the animal would not have developed general tuberculosis. Moreover a rabbit, No. 39, injected with an emulsion of the tissue from which the culture was made (prescapular gland) developed general tuberculosis. One can only conclude that the virulence of the virus from this animal had undergone a change during the artificial cultivation, and that the culture obtained from this calf,

the first of the series to develop general tuberculosis, was unstable as to its virulence.

This is a very important point, for, as the sequel will show, a similar observation was made in every one of the successful modification experiments, except H. 21. "G.B."

The culture from 337, the fellow animal to the fourth calf of the series, produced acute miliary tuberculosis in each of the two calves injected with it, both these animals being in a dying condition when killed 49 days after injection. The cultures from Calf 317 and from Bull 423A also caused acute miliary tuberculosis of a somewhat more severe kind and which proved more rapidly fatal, in 33, 35, 39 and 25 days respectively.

The culture injections, therefore, clearly demonstrate the change of virulence which had been previously shown by the injections of emulsions of tuberculous tissue, but they do not show so clearly that the change was a gradual one. This is largely because the strain derived from Calf 273 had entirely lost its virulence when tested.

There is some evidence that the virus after the fourth passage was slightly less virulent than it afterwards became. But the rabbits injected at the same time as these calves with 10, 1, and 0.1 mg. respectively do not confirm this. Nor do the calves injected with 10 mg. of the culture derived from Calf 337 lend it much support for these animals both developed fatal miliary tuberculosis and died in 63 and 91 days respectively. The duration of the disease was not so short in these as in many other animals injected with the same dose of a Group I culture, nevertheless the great variability in the susceptibility of different individual calves to tuberculosis makes it impossible to regard this as giving any strong support to the other evidence of a *gradual* increase of virulence.

BOVINE ANIMALS INJECTED WITH THE VIRUS H. 16. "J.H."

I.—Tissue Emulsions.

—	Number of Animal.	Mode of Inoculation.	Estimated dose of Tubercle Bacilli.	Fate of Animal and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
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BOVINES INJECTED WITH EMULSION OF TISSUES FROM HUMAN KNEE JOINT.

—	Calf 155	Subcutaneous	10,000	Killed when well after 54 days.	Local tuberculosis.
—	Calf 157	"	10,000	Killed when well after 67 days.	Slight tuberculosis.

BOVINES INJECTED WITH THE VIRUS DESCENDED FROM CALF 157.

1st Passage ...	Calf 187	Subcutaneous	3,002,000	Killed when well after 81 days.	Local tuberculosis.
2nd Passage...	Calf 273	"	10,903,325	Killed when in fair health after 89 days.	General tuberculosis, slight.
3rd Passage...	Calf 337	"	3,062,000	Killed when in fair health after 80 days.	General tuberculosis, slight.
	Calf 355	"	3,062,000	Killed when dying after 43 days.	General tuberculosis, moderate.
	Calf 281	"	10,900,000	Killed when very ill after 54 days.	General tuberculosis, severe.
	Calf 317	"	3,060,000	Killed when ill after 80 days.	General tuberculosis, moderate.
4th Passage ...	Calf 343	"	712,000	Killed when very ill after 68 days.	General tuberculosis, severe.
5th Passage...	Calf 371	"	10,000	Killed when well after 66 days.	General tuberculosis, slight.
	Bull 423A	"	157,266,000	Killed when very ill after 42 days.	General tuberculosis, severe.
	Heifer 245	"	157,266,000	Killed when in no immediate danger of death after 209 days.	General tuberculosis, moderate.

CALF INJECTED WITH THE VIRUS DESCENDED FROM CALF 155.

1st Passage ...	Calf 229	Subcutaneous	712,800	Killed when well after 91 days.	Local tuberculosis.
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BOVINE ANIMALS INJECTED WITH THE VIRUS H. 16. "J.H."—*continued*.

II.—Cultures (Calves only).

Subcutaneous.

—	Immediate Source of Culture.	Total Duration of Cultivation.	Number of Calf.	Weight in Kilos.	Fate of Animal and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
A.—DOSE: 50 MILLIGRAMMES.						
—	Guinea-pig 609, from human knee-joint.	14 months	527	69.39	Killed when well after 90 days.	Slight tuberculosis.
—	"	"	549	70.76	Killed when well after 89 days.	Local tuberculosis.
2nd Passage ...	Calf 273	10 months	567	83.46	Killed when well after 90 days.	Local tuberculosis.
"	"	"	573	63.50	Killed when well after 90 days.	Slight tuberculosis.
3rd Passage ...	Calf 337	13 months	789	50.34	Killed when dying after 49 days.	General tuberculosis, moderate.
"	"	"	795	46.25	Killed when dying after 49 days.	General tuberculosis, moderate.
4th Passage ...	Calf 317	10 months	711	40.82	Killed when dying after 33 days.	General tuberculosis, severe.
"	"	"	729	42.18	Killed when dying after 35 days.	General tuberculosis, severe.
5th Passage ...	Bull 423A	3 months	541	66.20	Killed when very ill after 25 days.	General tuberculosis, severe.
"	"	"	559	78.92	Killed when dying after 39 days.	General tuberculosis, severe.

B.—DOSE: 10 MILLIGRAMMES.

3rd Passage ...	Calf 337	13 months	779	50.80	Died after 63 days	General tuberculosis, moderate.
"	"	"	783	46.70	Died after 91 days	General tuberculosis, moderate.

RABBITS INJECTED WITH THE VIRUS H. 16. "J.H."

I.—Tissue Emulsions.†

Source of Material used for Injection.	Number of Rabbit.	Estimated dose of Tubercle Bacilli.	Killed or Died.	Duration of Life in Days.	Result.
Calf 273 ... (Prescapular gland.)	39	153,000	Died	61	General tuberculosis.
Calf 355 ... (Prescapular gland.)	66	4,210,000	"	85	General tuberculosis.
	67	4,210,000	"	29 (Intravenous)	General tuberculosis.
Rat 28 (injected with culture derived from human knee joint.)	334	—	Killed	220	Slight tuberculosis of peritoneum and kidneys.
	335	—	"	220	Slight tuberculosis of peritoneum and lungs. Trace in one kidney.

† All injections were intraperitoneal except where otherwise mentioned.

II.—Cultures.

A.—DOSE: 10 MILLIGRAMMES. *Intraperitoneal.*

—	Immediate Source of Culture.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.	Killed or Died.	Duration of Life in Days.	Result.
—	Guinea-pig 609, from human knee.	14 months	173	2,770	Killed	95	Slight tuberculosis somewhat widely distributed.
2nd Passage ...	Calf 273	10 months	206	1,560	"	90	Slight tuberculosis of peritoneum. Few tubercles in lungs and kidneys.
3rd Passage ...	Calf 337	13 months	445	1,120	Died	11	General tuberculosis.
"	"	19 months	699	1,370	"	15	Early general tuberculosis.

RABBITS INJECTED WITH THE VIRUS H. 16. "J.H."—*continued*.II.—CULTURES—*continued*.A.—DOSE: 10 MILLIGRAMMES. *Intraperitoneal*—*continued*.

—	Immediate Source of Culture.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.	Killed or Died.	Duration of Life in Days.	Result.
3rd Passage ...	Calf 355	19 months	670	1,500	Died	13	Early general tuberculosis.
"	"	"	671	1,300	"	19	General tuberculosis.
4th Passage ...	Calf 317	10 months	355	2,220	"	17	General tuberculosis.
5th Passage ...	Bull 423A	3 months	188	1,400	"	23	General tuberculosis.

B.—DOSE: 1 MILLIGRAMME. *Intraperitoneal*.

—	Guinea-pig 609, from human knee.	14 months	172	1,720	Killed	95	Slight tuberculosis of peritoneum. Four tubercles in lungs.
2nd Passage ...	Calf 273	10 months	205	1,670	"	90	Slight tuberculosis of peritoneum. Grey tubercles in lung and in one kidney.
3rd Passage ...	Calf 337	13 months	446	1,020	Died	18	Early tuberculosis. Death perhaps accelerated by psorospermiosis.
"	"	19 months	700	1,320	"	28	General tuberculosis.
"	"	"	701	1,300	"	21	General tuberculosis.
"	Calf 355	"	672	1,450	"	23	General tuberculosis.
"	"	"	673	1,450	"	22	General tuberculosis.
4th Passage ...	Calf 317	10 months	356	1,020	"	24	General tuberculosis.
5th Passage ...	Bull 423A	3 months	187	1,400	"	28	General tuberculosis.

C.—DOSE: 0.1 MILLIGRAMME. *Intraperitoneal*.

—	Guinea-pig 609 from human knee.	14 months	171	2,070	Killed	95	Slight tuberculosis of peritoneum. Three tubercles in lungs.
2nd Passage ...	Calf 273	10 months	204	1,500	"	90	Some tubercles in omentum, a few in lungs, one or two in kidneys and liver.
3rd Passage ...	Calf 337	13 months	447	1,370	Died	28	General tuberculosis.
"	"	19 months	702	1,070	"	107	General tuberculosis. (<i>Injection subcutaneous.</i>)
4th Passage ...	Calf 317	10 months	357	810	"	26	General tuberculosis.
"	"	17½ months	756	1,160	"	25	General tuberculosis.
5th Passage ...	Bull 423A	3 months	186	1,380	"	60	General tuberculosis.

INJECTIONS OF RABBITS MADE TO DETERMINE WHETHER THE VIRUS, AFTER IT HAD GAINED VIRULENCE FOR THE OX, CONTAINED A STRAIN OF BACILLI, BELONGING TO GROUP II., AND CAPABLE OF BEING ISOLATED BY MEANS WHICH PROVED SUCCESSFUL IN SEPARATING AN ARTIFICIAL MIXTURE OF GROUPS I. AND II., NAMELY, GROWTH ON GLYCERIN MEDIA.

One hypothesis which may be entertained to account for the change of virulence for bovines and rabbits, which took place in the virus in the course of this series of experiments, is that in the original virus composed in the main of bacilli belonging to our Group II., there were a few bacilli belonging to our Group I.; too few, indeed, to make any appreciable difference at first, but capable of being increased in relative numbers by cultivation in the bodies of suitable animals.

Another hypothesis postulates the accidental entrance into the virus, at some stage of the experiment, of bacilli belonging to our Group I.

A third hypothesis is that there was a true modification of a bacillus of Group II. into one of Group I.

Combining the first two together, we can speak of

the hypothesis of a mixture of two distinct kinds of bacilli, and the hypothesis of true modification.

Now, from an artificial mixture the virulent (for calves and rabbits) element had shown itself capable of being eliminated by repeated growth on glycerin media; not, however, with certainty (*see report on Experiments with Mixed Viruses, page 345*). Nevertheless, the experiment seemed worth trying with some of the strains obtained in the course of this modification experiment, because while only a positive result would be positive proof, a negative result would afford presumptive evidence on the other side. Accordingly several strains were tested in this way, but in no case was the virulence eliminated. The following tables will sufficiently explain themselves. The result of these experiments therefore was to give no support to the hypothesis that we were dealing with a mixture of bacilli.

CULTURE DERIVED FROM CALF 355, DIRECT. [3rd PASSAGE.]

Glycerin-Serum Series.

Culture 3 weeks old. Rabbits inoculated intraperitoneally.

	Total Duration of Artificial Cultivation.	Medium on which Final Culture was Grown.	Dose in mg.	Number of Rabbit.	Killed or Died.	Duration of Life.	Result.
16th Culture (After three generations on glycerin serum.)	19 months	Pure serum	10·0	666	Died	9 days	Early general tuberculosis.
	"	"	10·0	667	"	21 "	General tuberculosis.
	"	"	1·0	668	"	29 "	General tuberculosis.
	"	"	1·0	669	"	23 "	General tuberculosis.

Serum Series. [Controls.]

Culture 3 weeks old. Rabbits inoculated intraperitoneally.

16th culture on pure serum.	19 months	Pure serum	10·0	670	Died	13 days	Early general tuberculosis.
	"	"	10·0	671	"	19 "	General tuberculosis.
	"	"	1·0	672	"	23 "	General tuberculosis.
	"	"	1·0	673	"	22 "	General tuberculosis.

CULTURE DERIVED FROM CALF 337, DIRECT. [3rd PASSAGE.]

Glycerin-Serum Series.

Culture 3 weeks old. Rabbits injected intraperitoneally.

17th culture (After four generations on glycerin serum.)	19 months	Pure serum	10·0	695	Died	12 days	Early general tuberculosis.
	"	"	1·0	696	"	101 "	Severe tuberculosis of kidneys and lungs. Subcutaneous tumour. (Injection partly subcutaneous.)
	"	"	1·0	697	"	24 "	General tuberculosis.
	"	"	0·1	698	"	94 "	General tuberculosis. (Injection partly intracæcal.)

Serum Series. [Controls.]

Culture 3 weeks old. Rabbits injected intraperitoneally.

17th culture on pure serum.	19 months	Pure serum	10·0	699	Died	15 days	Early general tuberculosis.
	"	"	1·0	700	"	"	General tuberculosis.
	"	"	1·0	701	"	"	General tuberculosis.
	"	"	0·1	702	"	"	General tuberculosis. Injection subcutaneous.

CULTURE DERIVED FROM CALF 317, DIRECT. [4th PASSAGE.]

Glycerin-Serum Series.

Cultures 3 weeks old. Rabbits inoculated intraperitoneally.

On pure serum (After three generations on glycerin-serum.)	17½ months	Pure serum	10·0	751	Died	21 days	General tuberculosis. (Injection partly intracæcal.)
	"	"	10·0	752	"	12 "	Early general tuberculosis.
	"	"	1·0	753	"	15 "	General tuberculosis.
	"	"	0·1	754	"	17 "	General tuberculosis.

CULTURE DERIVED FROM CALF 317, DIRECT [4TH PASSAGE]—continued.

GLYCERIN-SERUM SERIES—continued.

Cultures 3 weeks old. Rabbits inoculated intraperitoneally.

	Total duration of Artificial Cultivation.	Medium on which Final Culture was Grown.	Dose in mg.	Number of Rabbit.	Killed or Died.	Duration of Life.	Result.
4th generation on glycerin-serum.	17½ months	Glycerin-serum	10·0	747	Died	34 days	General tuberculosis.
	"	"	10·0	748	"	17 "	General tuberculosis.
	"	"	1·0	749	"	24 "	General tuberculosis.
	"	"	1·0	750	"	15 "	General tuberculosis.

Serum Series. [Controls.]

Culture 3 weeks old. Rabbits inoculated intraperitoneally.

16th culture on pure serum.	17½ months	Pure serum	1·0	755	Died	6 days	Psorospermiosis.
	"	"	0·1	756	"	25 "	General tuberculosis.

MODIFICATION OF VIRULENCE OF THE VIRUS H. 17. "Sp.B."

The next series of experiments in which a change of virulence was observed had for its starting point the sputum collected during four months from many patients in a large hospital.

Now, our experiments have shown that tubercle bacilli possessing a high degree of virulence for the ox and rabbit may be obtained from the human lung in some of those cases where the primary seat of disease is in the mesenteric glands (*e.g.*, H. 32. "Y.W." and H. 59. "L.B."; compare also H. 49. "T.C."). It is therefore not impossible that sputum from an exceptional case of this kind may have got mixed with that from the other cases, and that we were dealing from the beginning with a mixture of bacilli some belonging to our Group II. and others to our Group I., the latter being at first in a very small minority. This possibility must be borne in mind, though, as the sequel will show, we were unable to obtain any confirmation of it, and indeed on the contrary some evidence against it.

The facts of this series of experiments are as follows. Four young calves, Nos. 161, 167, 169 and 171, were fed daily with sputum, Sundays excepted, one (161) for three and the others for four months. The former received in all about 21 litres of sputum, the latter about 31 litres each.

From one of these calves (No. 169) sprang the series of animal injections which resulted in a change of virulence of the virus.

The four original calves were killed at periods varying from 4 to 5½ months after the commencement of the feeding. At the post-mortem examinations of all these animals minimal lesions alone were found, consisting of a few small yellow points in the Peyer's patches of the small intestine, and some small calcareous foci in the mesenteric and posterior pharyngeal glands. Emulsions made from the affected glands both of Calves 161 and 169, and injected into rabbits, failed to produce general tuberculosis. It is therefore almost certain that no tubercle bacilli of the kind belonging to the human Group I. were present in the tuberculous lesions of these calves, for even very minute doses of these bacilli have been found to be capable of producing progressive tuberculosis in the rabbit.

An emulsion of the affected glands of Calf 161 was injected subcutaneously into Calves 227 and 265. Tubercle bacilli were very scanty in this emulsion and the dose received by these animals was estimated to

contain only 43,000 and 49,000 respectively. When the animals were killed 4 months later minimal lesions were found in one and no lesions at all in the other. A strain of culture was raised from one of them, No. 265, and was injected subcutaneously in 50 mg. doses into Calves 583 and 601, without causing anything more than minimal lesions.

From No. 171, another of the calves fed with tuberculous sputum, an emulsion was made of the affected glands, and injected subcutaneously into Calf 277. Tubercle bacilli were scanty and the dose was estimated to contain 76,000 only. It caused only minimal lesions.

An emulsion made from the lesions of this calf and injected subcutaneously into another, No. 341, in a dose containing 700,000 bacilli, also produced minimal lesions. Thus no modification was obtained in these two series of injections into calves.

So far the number of tubercle bacilli in the doses of tissue emulsion used in this experiment had been very small, and it was obviously desirable to inject larger numbers.

Accordingly, when Calf 167, the next of those fed with tuberculous sputum, was killed, the virus was passed through three guinea-pigs in succession, the first being injected with an emulsion of the mesenteric glands of Calf 167. From the third of these an emulsion was made, and a dose estimated to contain 4,500,000 tubercle bacilli was injected subcutaneously into Calf 391. Again only minimal lesions were produced, which in this case included some minute translucent foci in the lungs.

The virus from this calf was afterwards used for a succession of very young kids, but neither in these animals could progressive tuberculosis be produced. (*See* chart of experiment, Vol. VII of Appendix.)

We now come to Calf 169, the last of the sputum-fed animals, and the one from which a long series of injections descended.

When it was killed an emulsion was made of the affected glands, and the virus passed through two guinea-pigs in succession, in order to get a large number of tubercle bacilli. An emulsion of the last of these guinea-pigs was made and injected subcutaneously into Calf 339 in a dose estimated to contain 166,000,000 tubercle bacilli. It was killed 69 days later, and no tuberculous lesions were found beyond the prescapular gland.

A strain of culture was raised from this animal

through Guinea-pig 1235. And of this 50 mg. injected subcutaneously into Calves 679 and 681 also produced minimal lesions.

Rabbits injected with an emulsion of the tuberculous organs of the same guinea-pig failed to develop progressive tuberculosis. It is therefore certain that at this stage of the experiment the virus belonged to the human Group II, for it had repeatedly failed to produce anything more than minimal lesions in the calf, even when very large doses, either of culture or tuberculous tissue, were used; and it is practically certain then that tubercle bacilli of the human Group I. were entirely absent, because in no case had a progressive tuberculosis developed in the rabbit.

From the guinea-pig infected from the prescapular gland of Calf 339 a long series of calves injected intravenously descends, six animals being thus dealt with in succession.*

The first of these, No. 475, is important. It was injected in the jugular vein with 20 cc. of an emulsion estimated to contain 104,000,000 tubercle bacilli—a large dose for intravenous injection. The temperature rose on the twelfth day after inoculation, and reached 41.8° C. on the eighteenth day. In the fifth week it fell to between 39° and 40° C., but never reached the normal. The animal was at one time ill, the respiration being somewhat severely affected. When the temperature fell the general health slowly improved; but the rate of growth remained very low, and an opacity appearing in the cornea of each eye, the animal gradually went blind.

It was killed 88 days after inoculation.

At the post-mortem examination each lung was found to contain a group of small cavities in the posterior corner occupying the last two or three inches. They were thin-walled, and contained thick tenacious pus. Calcareous grains were found adhering to their walls. Besides these were several dense caseous nodules very well defined, one being shaped like an egg and over an inch in length. There were in addition a few small fibrous tubercles. The bronchial and mediastinal glands were enlarged to about double their normal size; they were firmer than normal, and contained nodules full of caseous foci. Two small tubercles were found in the liver, and tubercles were found in the choroid of both eyes. There was nothing to indicate the seat of inoculation, the vein there being normal, but a deep cervical gland the size of a flattened pea was caseous, and one hyoid gland contained a caseating nodule. Tubercle bacilli were found in one orbital gland, and there were calcareous foci in the peribronchial glands. The rest of the animal was healthy.

The softening in the caseous nodules in the lungs was unusual, not having been seen before in our experimental animals; and this raised the question whether so advanced a lesion could have been produced within the 88 days which elapsed between injection and death, and whether it might not have been a spontaneous antecedent lesion.

The rabbits injected at the same time and with the same emulsion as this calf developed only minimal lesions.

An emulsion was made from the lung of Calf 475 and injected intravenously into Calf 539, in a dose estimated to contain 209,000,000 tubercle bacilli, and also into two rabbits, 169 and 170. The calf was killed 18 days later when in a dying condition, and was found to have acute tuberculous consolidation of the lungs. The rabbits which were injected, one intraperitoneally and the other intravenously, died in a few weeks of general tuberculosis. The doses were very large, being 459,000,000 and 41,750,000 respectively.

An emulsion was made of the lung of this calf and injected intravenously into Calf 529, the dose being estimated to contain 1,021,000,000 bacilli, and intraperitoneally into Rabbits 180 and 181, dose 817,000,000 and 1,226,000,000 respectively.

The calf died in 13 days of consolidation of lung. Tubercle bacilli were found in all the organs commonly susceptible of tuberculosis. The rabbits also died of general tuberculosis in a little over 3 weeks, the doses having been extremely large.

The next Calf, No. 553, was injected intravenously with an emulsion made from the lung of the preceding calf, the dose being estimated to contain 99,000,000 tubercle bacilli. Rabbits were also inoculated intraperitoneally, the dose being the same as that given to the calf.

The calf was in a dying condition when killed 18 days after injection. It had tuberculous endocarditis, tuberculous consolidation of lungs, numerous miliary tubercles in the liver, and numerous tubercle bacilli in the spleen. The rabbits died of general tuberculosis within 4 to 5 weeks.

After this the series of intravenous injections was still continued, but it was thought desirable to test the virulence of the virus at this stage by injecting calves subcutaneously. Consequently with the emulsion made from the thoracic glands of the preceding calf not only was a calf injected intravenously, and two rabbits intraperitoneally as before, but in addition two calves, 531 and 555, were injected subcutaneously. It will be convenient to consider these two animals first.

The dose, 150,000,000 bacilli, was chosen to correspond nearly with that given to Calf 339, the animal which precedes the intravenous calves in the series, and which failed to develop any lesions beyond the prescapular gland. No. 555 died of general tuberculosis 58 days after injection, and No. 531 was in a dying condition when killed on the following day. The virus was thereby proved to have become highly virulent for calves. The rabbits also, which received a dose of 11,000,000 bacilli, died of general tuberculosis within five weeks.

To return to the intravenous series. At the same time that the two calves just described were injected subcutaneously, Calf 557 was injected intravenously with the same emulsion, the dose being estimated to contain 49,000,000 bacilli. The animal was killed when dying 17 days later. There was the usual tuberculous consolidation of lungs, and tubercle bacilli in other organs.

An emulsion was made of the thoracic glands of this animal and injected into the veins of Calf 571, the last of the intravenous series, and into rabbits 210 and 211. The dose given to the calf was considerably smaller than that hitherto used. It was estimated to contain 10,000,000 tubercle bacilli. The animal died in 26 days, with the usual tuberculous consolidation affecting the greater part of the lungs, and with miliary tuberculosis elsewhere. As the number of bacilli injected was less than that in the preceding animals the tubercles also were less numerous, and since the animal had lived a little longer they were rather larger in size. The rabbits, which had received 5,000,000 tubercle bacilli each, developed a somewhat slowly progressing tuberculosis. No. 210, which had inadvertently been injected into the abdominal wall instead of into the peritoneum, died of severe tuberculosis of lungs 87 days after inoculation. This in itself would perhaps not be worth mentioning, seeing that subcutaneous injection in the rabbit always produces a far less rapidly fatal tuberculosis than intraperitoneal injection does. The other rabbit, however, which was injected in the peritoneum, lived 100 days. There is no note in the post-mortem record indicating that any accident had occurred, such as injection partly into the cæcum. The rabbit was found to have slight tuberculous peritonitis and severe tuberculosis of lungs and kidneys.

There is another fact which shows perhaps that the virulence of the virus at this its final stage was perhaps a little less than that of the viruses of Group I. A young bull, No. 611, about seven months old (weight 2 cwt. 3 qrs. 3 lbs.) was subcutaneously injected with an emulsion of left bronchial gland from Calf 531 with a dose estimated to contain 122,000,000 tubercle bacilli.

This animal, after developing a swelling at the seat of injection, and being more or less indisposed, apparently recovered, and grew to be a fine strong bull. Fourteen and a half months after injection it gave a very good reaction to tuberculin, although it appeared to have nothing the matter with it.

It was killed eighteen months after injection, and

* It had already been found that the ox might be killed with bacilli belonging to Group II. if these were injected intravenously and in large enough doses. For these bacilli can produce local lesions at the seat of inoculation, and in the case of intravenous injections the local lesions are in the lungs, and if these are sufficiently numerous they may prove fatal. Intravenous injection therefore seemed a favourable method of growing bacilli of Group II. in the ox.

was found to be in very good general condition, but there were many yellow calcareous and caseous tubercles in the lungs, some collected together in collapsed lobules, and there was one lobule which appeared to be affected by quite recent tuberculous broncho-pneumonia. Most of the lymphatic glands of the body contained rather large calcareous tubercles.

The significance of this result can only be ascertained by comparing it with others produced by bacilli of Group I. injected into young adult animals. Since the influence of dose is considerable, comparison is only useful when doses are approximately equal. Two animals may be cited for comparison.

Cow 63, H. 2. "Sp.A." received 158,000,000 bacilli injected subcutaneously, and died of general tuberculosis 45 days later. Heifer 197, H. 14. "F.S." received 85,000,000 bacilli, and was killed when ill 51 days later, and was found to have general tuberculosis. On the other hand, Heifer 251 received a very much larger dose, namely, 2,800,000,000 tubercle bacilli of the virus H. 29. "M.F." was killed when apparently well 138 days later, and was found to have tuberculosis, general indeed, but not severe. And Heifers 233 and 247 received 53,440,000 tubercle bacilli, and were not at all severely affected when killed 180 days afterwards. These facts lead one to regard the recovery of Bull 611 not as evidence of the failure of the virus at that stage to reach the standard of virulence of Group I., but rather as another example of the occasionally great resisting power of the older animals of the species.

CULTURE INJECTIONS.

In order to have a more exact idea of the virulence of this virus at the various stages of its modification, cultures were obtained from various animals of the series and tested by the injection of standard doses into calves and rabbits. Since there is evidence that the virulence of some of these strains was unstable under the conditions of artificial cultivation, the age of each strain (total duration of artificial cultivation) at the time its virulence was first tested is stated. The actual cultures which yielded the bacilli injected were in every case three weeks old.

Four strains of culture were tested, namely:—

No. 1. Obtained from Guinea-pig 1235, which had been injected with an emulsion of the prescapular gland of Calf 339, and which stands at the head of the series of calves injected intravenously.

No. 2. Obtained from Rabbit 181, injected with an emulsion from the second intravenous Calf No. 539.

No. 3. Obtained from the fourth intravenous Calf No. 553, through a guinea-pig.

No. 4. Obtained directly from the sixth intravenous Calf No. 571.

One would have liked to have used a culture from the first intravenous Calf No. 475, but unfortunately this was not obtained.

The total duration of cultivation of the four strains when tested was as follows:—

No. 1. 8 months.

No. 2. 10 months, 16 months, and 19½ months.

No. 3. 3 months.

No. 4. 3½ months.

These strains of culture were injected subcutaneously into calves and rabbits. Each strain, except No. 3, was injected in 50 milligramme doses into two calves. No 3 was injected in a dose of 50 milligrammes into one calf only, but it was also injected into two others in doses of 10 milligrammes.

The result of these injections was as follows:—

No. 1 (1st passage). Produced in Calves 679 and 681 no more than minimal lesions, which did not extend beyond the glands nearest the seat of injection.

Strain No. 2 (3rd passage), namely, that from Rabbit 181, had existed 10 months under artificial cultivation when injected into Calves 891 and 911. It produced a general tuberculosis, which, however, was not so rapidly fatal as that usually produced by viruses of Group I. Indeed both animals lived somewhat longer than any other of the calves injected with 50 milligrammes of the viruses of Group I., two alone excepted. Thus the virulence at this stage, though undoubtedly high for the calf, is not quite up to the standard of a Group I. virus. (See diagram

representing the duration of life of calves injected with 50 milligrammes of culture of viruses of Group I. in Appendix to 2nd Interim Report Vol. II, page 1029.)

The rabbits injected with this strain support this conclusion, though somewhat feebly. One which received 10 milligrammes died in 23 days, which is not an extreme period for an animal injected with this dose of a virus of Group I. Another injected with 1 milligramme, however, survived for 49 days, a period which is almost unknown with this dose, and which is much above the average.

Strain No. 3 (5th passage) was injected into Calf 897, 50 milligrammes, and Calves 901 and 909, 10 milligrammes.

The 50-milligramme animal died of general tuberculosis in 32 days, a period which is less than the average for calves injected with viruses of Group I. The 10-milligramme calves both died of general tuberculosis in 54 and 31 days respectively, which is well within the average for this dose. Rabbits injected with the same culture died in the usual time of general tuberculosis.

Strain No. 4 (7th passage), namely, that from the last calf of the intravenous series, was injected into two calves, 739 and 743, in 50-milligramme doses. Both developed acute general tuberculosis and were killed in a dying condition, the one 33 and the other 37 days after injection.

Rabbits injected with the same culture died of general tuberculosis.

From the calves injected with these cultures therefore we may draw the conclusion that the strain which was originally incapable of setting up a progressive tuberculosis, or indeed anything more than a minimal local tuberculosis, in calves, became after passing successively through four of these animals intravenously injected, as virulent for bovines as the viruses of human Group I. Further passage through bovines served only to maintain this degree of virulence.

The full virulence, however, does not appear to have been reached suddenly. The virus from Rabbit 181, which had been injected from the second intravenous calf, though highly virulent for calves, was not quite up to the standard of virulence of Group I. viruses.

The rabbits inoculated with culture confirm the conclusion already drawn from the fate of the calves, namely, that the strain derived from Calf 553 and subsequent animals was fully virulent, while that derived from Rabbit 181 was of distinctly less virulence.

This strain of tubercle bacilli derived from Rabbit 181 is of great importance. We have seen that it proved itself virulent for both calves and rabbits, but that its virulence fell a little short of the standard of Group I.

Subsequently, as will now be described, its virulence was found to be unstable.

At the time when the first tests were made with this strain it had been growing for 10 months in artificial culture, always on bovine serum (without addition of glycerin).

When the strain had been growing in artificial cultivation for 16 months its virulence was again tested. As large and small colonies had appeared on a glycerin serum tube, a strain was raised from each of these on pure serum, and injected into rabbits. At the same time control injections were made with the strain which had always been kept on pure serum. All these proved to have the low degree of virulence for the rabbit characteristic of our Group II.

This loss of virulence was confirmed on the ox and rabbit when the strain had been growing for 19½ months in artificial cultivation on pure serum. Two calves Nos. 1083 and 1103, were injected subcutaneously with 100 and 30 milligrammes of bacilli respectively, and 4 rabbits intraperitoneally, two with 10, and two with 1, milligrammes of bacilli.

These animals remained well for nearly 3 months, and the resulting lesions were minimal.

These results may be summarised as follows:—

The rabbit from which the strain was raised, No. 181, and its fellow 180, had died in the short period of 22 and 25 days respectively, and the calf injected with the same virus had also died very rapidly. Thus there is no reason to think that the virulence of the strain

at this period was anything less than the standard of Group I., though the fact that large doses were used prevents us from being certain that it was fully up to this standard. After 10 months of artificial cultivation on pure serum the virulence was still high, though slightly less than the standard of Group I.; and 6 months later still it had fallen to the standard of a Group II. virus, and was no longer capable of producing a progressive tuberculosis in rabbits. Shortly after it was proved to have a low degree of virulence for the calf.

Thus the newly-acquired virulence of this virus, shown by the strain from Rabbit 181, was unstable, and proved capable of modification in both directions; when first tested it was not quite up to the standard of Group I.; but it fully attained this standard after passing through another calf. On the other hand, under the conditions of artificial culture on pure serum, the virulence, such as it possessed, became degraded to the standard of Group II. As will be seen in the sequel, another strain belonging to one of the viruses concerned in a modification experiment (H. 49, "T.C.") behaved in precisely the same way. This is not inconsistent with the hypothesis that we were dealing with a mixture.

Finally, a few words may be said about the cultural characters of these and other strains in the "Sp.B" series.

All those strains which were derived from animals infected with the virus before it had acquired virulence for calves and rabbits grew luxuriantly upon glycerin media, and were, according to our nomenclature,

eugonic. These strains were derived from Calf 265 direct, and from Calf 339, through Guinea-pig 1235.

The strains derived from the calves injected with the virus after it had acquired full bovine virulence grew badly upon glycerin media. They were as follows:—

From Calf 553 (5th Passage) through Guinea-pig 1542. Calf 571 (7th) direct.

The culture from Rabbit 181 grew well upon glycerin media, and may on the whole be described as eugonic.

In reviewing this large and complicated experiment, two facts stand out prominently; firstly, that starting with a virus which was a typical member of the human Group II., and which, as the rabbits infected with it show, could not have contained even a few stray bacilli of the human Group I., one ended with a virus which was a typical member of Group I., and was identical with other members of this group, both in cultural characters and in virulence, this change being brought about during the course of a series of injections from animal to animal. Secondly that from somewhere in the middle of this series a strain of bacilli was obtained which may or may not have been when freshly isolated fully as virulent as members of Group I., but which certainly fell a little short of this standard after it had been 10 months in cultivation, and which a little later had lost its virulence altogether for the ox and rabbit.

In this respect the "Sp.B." experiment falls into line with the preceding one with H. 16. "J.H.", and as we shall see with the succeeding experiments with H. 13, "A.D." and H. 49, "T.C."

CALVES AND GOATS INJECTED WITH THE VIRUS H. 17. "Sp.B."

I.—Tissue Emulsions.

	Number of Animal.	Mode of Injection.	Estimated dose of Tubercle Bacilli.	Fate of Animal and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
FOUR ORIGINAL CALVES FED WITH SPUTUM.					
—	Calf 161	Feeding	—	Killed when well after 125 days.	Slight tuberculosis of intestine, mesenteric and pharyngeal glands.
—	Calf 167	"	—	Killed when well after 168 days.	Slight tuberculosis of intestine, mesenteric and pharyngeal glands.
—	Calf 171	"	—	Killed when well after 154 days.	Slight tuberculosis of intestine, mesenteric and pharyngeal glands.
—	Calf 169	"	—	Killed when well after 169 days.	Slight tuberculosis of intestine, mesenteric and pharyngeal glands.

(1) ANIMALS INJECTED WITH THE VIRUS DESCENDED FROM CALF 161.

1st Passage ...	Calf 227	S.	43,329	Killed when well after 114 days.	Normal throughout.
"	Calf 265	S.	49,995	Killed when well after 107 days.	Slight tuberculosis.

(2) ANIMALS INJECTED WITH THE VIRUS DESCENDED FROM CALF 167.

1st Passage ...	Calf 391	S.	41,600,000	Killed when well after 40 days.	Slight tuberculosis.
2nd Passage...	Goat 37	S.	102,340,000	Killed when well after 231 days.	Slight tuberculosis.
"	Goat 39	S.	102,340,000	Killed when well after 92 days.	Slight tuberculosis.
3rd Passage...	Goat 43	S.	4,269,000	Killed when well after 137 days.	Slight tuberculosis.
"	Goat 45	V.	1,067,000	Killed when well after 137 days.	Local tuberculosis.

(3) ANIMALS INJECTED WITH THE VIRUS DESCENDED FROM CALF 171.

1st Passage ...	Calf 277	S.	76,002	Killed when well after 89 days.	Slight tuberculosis.
2nd Passage...	Calf 341	S.	700,000	Killed when well after 70 days.	Local tuberculosis.

S = Subcutaneous.

V = Intravenous.

CALVES AND GOATS INJECTED WITH THE VIRUS H. 17. "Sp.B."—*continued*.I.—TISSUE EMULSIONS—*continued*.

	Number of Animal.	Mode of Injection.	Estimated dose of Tubercle Bacilli.	Fate of Animal and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
(4) ANIMALS INJECTED WITH THE VIRUS DESCENDED FROM CALF 169.					
1st Passage ...	Calf 339	S.	165,853,000	Killed when well after 69 days.	Local tuberculosis.
2nd Passage...	Calf 475	V.	104,240,000	Killed when well after 88 days.	General tuberculosis, slight.
3rd Passage...	Calf 539	V.	208,700,000	Killed when dying after 18 days.	General tuberculosis.
4th Passage...	Calf 529	V.	1,021,200,000	Died after 13 days	General tuberculosis.
5th Passage...	Calf 553	V.	99,000,000	Killed when dying after 18 days.	General tuberculosis.
6th Passage...	Calf 557	V.	48,919,000	Killed when dying after 17 days.	General tuberculosis.
"	Calf 555	S.	150,520,000	Died after 58 days	General tuberculosis, severe.
"	Calf 531	S.	150,520,000	Killed when dying after 59 days.	General tuberculosis, severe.
7th Passage...	Calf 571	V.	10,000,000	Died after 26 days	General tuberculosis.
"	Bull 611	S.	122,400,000	Killed when well after 571 days.	General tuberculosis, slight and not very obviously progressive.

S = Subcutaneous.

V = Intravenous.

RABBITS INOCULATED† WITH THE VIRUS H. 17. "Sp.B."

I.—Tissue Emulsions.

Source of Material used for Injection.	Number of Rabbit.	Estimated dose of Tubercle Bacilli.	Killed or Died.	Duration of Life in Days.	Result.
Calf 161 (Mesenteric and pharyngeal glands.)	11	—	Killed	175	No tuberculosis.
" " "	12	—	"	175 (Subcutaneous.)	No tuberculosis.
Calf 171 (Mesenteric glands.)	17	—	Died	5	No tuberculosis. Death due to psorospermiosis.
" " "	18	—	"	16 (Subcutaneous.)	No tuberculosis. Cause of death unknown.
Calf 277 (Prescapular gland.)	52	52,500	Killed	95	Few tubercles in omentum and lungs.
Guinea - pigs 1132-1133 (third series from Calf 167).	76	4,160,000	"	130	Slight tuberculosis of kidneys and mammary gland.
" " "	77	4,160,000	"	130 (Intravenous.)	One tubercle in each lung.
Calf 391 (Local lesion and prescapular gland.)	89	13,645,000	"	93 (Intravenous.)	Slight tuberculous pyelitis of left kidney.
" " "	90	13,645,000	"	93	One tubercle in lung.
Kid 39 (Prescapular gland.)	127	427,000	Died	66 (Intravenous.)	No tuberculosis.
" " "	128	2,134,000	Killed	119	Normal except that the injected material was encysted in peritoneum.
Calf 169 (Mesenteric glands.)	26	—	Died	11	Slight tuberculosis of peritoneum. Tuberculous abscess in peritoneum. ? cause of death.
" " "	27	—	Killed	170 (Subcutaneous.)	Few minute tubercles in lungs.
Guinea-pig 1235, from Calf 339.	108	20,848,000	"	77	Slight tuberculosis of peritoneum. Some translucent tubercles in lungs, few in kidneys.
" " "	109	10,424,000	"	77 (Intravenous.)	A few minute grey tubercles in lung, liver, and kidneys.
Calf 685. (Inoculated with culture from Calf 339.)	380	—	"	191	No tuberculosis.

† All injections were intraperitoneal, except where otherwise mentioned.

RABBITS INOCULATED† WITH THE VIRUS H. 17. "Sp.B."—*continued.*I.—TISSUE EMULSIONS—*continued.*

Source of Material used for Injection.	Number of Rabbit.	Estimated dose of Tubercle Bacilli.	Killed or Died.	Duration of Life in Days.	Result.
Calf 475 ... (Lung.)	169	459,140,000	Died	33	General tuberculosis, acute.
" "	170	41,740,000	"	30	General tuberculosis.
Calf 539 ... (Lung.)	180	816,960,000	"	(Intravenous.) 25	General tuberculosis.
" "	181	1,225,440,000	"	22	General tuberculosis; very early in lungs, kidneys not affected.
Calf 529 ... (Thoracic glands.)	189	99,000,000	"	31	General tuberculosis.
" "	190	99,000,000	"	34	General tuberculosis.
Calf 553 ... (Thoracic glands.)	196	11,289,000	"	34	General tuberculosis.
" "	197	11,289,000	"	34	General tuberculosis.
Calf 557 ... (Lung.)	210	5,000,000	"	87	Severe tuberculosis of lungs.
" "	211	5,000,000	"	(Subcutaneous.) 100	Slight tuberculosis of peritoneum. Severe tuberculosis of lungs and kidneys.

† All injections were intraperitoneal, except where otherwise mentioned.

CALVES INJECTED WITH THE VIRUS H. 17. "Sp.B."

II.—Cultures.

Subcutaneous Injections.

—	Immediate Source of Culture.	Total Duration of Cultivation.	Number of Calf.	Weight in Kilos.	Fate of Animal, and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
A. DOSE: 50 MILLIGRAMMES.						
[Strain derived from Calf 161.]	Calf 265 ...	10 months	583	50.80	Killed when well after 90 days.	Local tuberculosis.
"	"	"	601	52.61	Killed when well after 90 days.	Slight tuberculosis.
1st Passage ... [Strain derived from Calf 169.]	Guinea - pig 1235, from Calf 339.	8 months	679	57.60	Killed when well after 91 days.	Local tuberculosis.
"	"	"	681	60.32	Killed when well after 91 days.	Local tuberculosis.
3rd Passage ...	Rabbit 181, from Calf 539.	10 months	891	46.25	Died after 48 days	General tuberculosis, moderate.
"	"	"	911	55.34	Died after 58 days	General tuberculosis, severe.
5th Passage ...	Guinea - pig 1542, from Calf 553.	3 months	897	48.50	Died after 32 days	General tuberculosis, severe.
7th Passage ...	Calf 571 ...	3½ months	739	39.46	Dying after 33 days	General tuberculosis, severe.
"	"	"	743	38.10	Dying after 37 days	General tuberculosis, severe.
B. DOSE: 10 MILLIGRAMMES.						
5th Passage ... [Strain derived from Calf 169.]	Guinea - pig 1542 from Calf 553.	3 months	901	50.34	Died after 54 days	General tuberculosis, severe.
"	"	"	919	45.80	Died after 31 days	General tuberculosis, severe.

RABBITS INJECTED WITH THE VIRUS H. 17. "Sp.B."

II.—Cultures.

(a) Strain derived from Calf 169.

	Immediate Source of Culture.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.	Killed or Died.	Duration of Life in Days.	Result.
A.—DOSE: 50 MILLIGRAMMES. <i>Intraperitoneal.</i>							
1st Passage	Guinea-pig 1235, from Calf 339.	8 months	265	1,230	Died	73	Trace of tuberculosis in one kidney. Death from non-tubercu- lous pneumonia.
3rd Passage	—	—	—	—	—	—	—
5th Passage	—	—	—	—	—	—	—
7th Passage	—	—	—	—	—	—	—
B.—DOSE: 10 MILLIGRAMMES. <i>Intraperitoneal.</i>							
1st Passage	Guinea-pig 1235, from Calf 339.	8 months	266	1,190	Killed	91	Very slight tuber- culosis of peritoneum. Few tubercles in lungs and left kidney.
3rd Passage	Rabbit 181, from Calf 539.	10 months	595	1,190	Died	23	General tuberculosis.
5th Passage	Guinea-pig 1542, from Calf 553.	3 months	599	2,830	"	13	Early general tuber- culosis. (?) Cause of death.
7th Passage	Calf 571.	3½ months	364	820	"	16	General tuberculosis.
C.—DOSE: 1 MILLIGRAMME. <i>Intraperitoneal.</i>							
1st Passage	Guinea-pig 1235, from Calf 339.	8 months	267	1,230	Killed	91	Slight tuberculosis of peritoneum and lungs.
3rd Passage	Rabbit 181, from Calf 539.	10 months	596	1,220	Died	49	General tuberculosis.
"	"	"	597	1,210	"	65	General tuberculosis. (Injection partly intramuscular.)
5th Passage	Guinea-pig 1542, from Calf 553.	3 months	600	1,560	"	19	General tuberculosis.
"	"	"	601	1,310	"	81	General tuberculosis. (Injection partly intramuscular.)
7th Passage	Calf 571	3½ months	365	600	"	23	General tuberculosis.
D.—DOSE: 0.1 MILLIGRAMME. <i>Intraperitoneal.</i>							
1st Passage	—	—	—	—	—	—	—
3rd Passage	Rabbit 181, from Calf 539.	10 months	598	1,020	Died	29	Early tuberculosis complicated by cysticercosis.
5th Passage	Guinea-pig 1542, from Calf 553.	3 months	602	1,360	"	119	General tuberculosis. (Injection intracæcal.)
7th Passage	Calf 571	3½ months	366	660	"	37	General tuberculosis.
E.—DOSE: 0.01 MILLIGRAMME. <i>Intraperitoneal.</i>							
1st Passage	—	—	—	—	—	—	—
3rd Passage	—	—	—	—	—	—	—
5th Passage	—	—	—	—	—	—	—
7th Passage	Calf 571	3½ months	367	750	Died	40	General tuberculosis.

RABBITS INJECTED WITH THE VIRUS H. 17. "Sp.B."—*continued.*II.—CULTURES—*continued.*

(b) Strain derived from Calf 161.

Immediate Source of Culture.	Total Duration of Cultivation.	Dose in Milligrammes.	No. of Rabbit.	Weight in Grammes.	Killed or Died.	Duration of Life.	Result.
Calf 265 Injected with emulsion of lesions from Calf 161.	10 months	10.0	232	2,260	Killed	90 days	Slight tuberculosis of peritoneum and kidneys. A trace in lungs.
"	"	1.0	231	2,130	"	90 days	Slight tuberculosis of peritoneum, lungs, and kidneys.
"	"	0.1	230	1,930	"	90 days	Trace of tuberculosis in peritoneum and lungs.

TABLES SHOWING LOSS OF VIRULENCE FOR CALVES AND RABBITS OF THE STRAIN OF CULTURE DERIVED FROM CALF 539 [3rd PASSAGE] THROUGH RABBIT 181, AFTER GROWTH FOR MANY GENERATIONS ON ARTIFICIAL MEDIA.

Culture Medium used: Pure Bovine Serum only.

A.—CALVES.

Total Duration of Cultivation.	Number of Calf.	Weight in Kilos.	Dose in Milligrammes.	Fate of Animal and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
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(a) BEFORE LOSS OF VIRULENCE.

10 months	{	891	46.25	50 mg.	Died after 48 days	General tuberculosis, moderate.
		911	55.34	50 mg.	Died after 58 days	General tuberculosis, severe.

(b) AFTER LOSS OF VIRULENCE.

19½ months	{	1083	48.95	100 mg.	Killed when well after 81 days.	Slight tuberculosis.
		1103	37.64	30 mg.	Killed when well after 82 days.	Local tuberculosis.

B.—RABBITS.

Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.	Dose in mg.	Killed or Died.	Duration of Life.	Result.
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(a) BEFORE LOSS OF VIRULENCE.

10 months	{	595	1,190	10.0	Died	23 days	General tuberculosis.
		596	1,220	1.0	"	49 days	General tuberculosis.

(b) AFTER LOSS OF VIRULENCE.

16 months	{	804	1,270	1.0	Killed	52 days	Slight chronic tuberculosis of peritoneum and lungs. Uterus filled with tuberculous deposit.
		805	1,380	1.0	"	92 days	Slight tuberculosis of peritoneum, lungs, and kidneys; very retrogressive in the former.
16½ months	{	828	900	1.0	"	37 days	Slight chronic tuberculosis of peritoneum, lungs and kidneys. (Injection partly intracæcal.)
		829	920	0.1	"	145 days	Trace of tuberculosis in peritoneum only.
19½ months	{	924	1,400	10.0	"	82 days	Slight tuberculosis of peritoneum and lungs.
		925	1,420	10.0	"	82 days	Local lesion; slight tuberculosis of lungs. (Injection subcutaneous.)
		926	1,310	1.0	"	82 days	Slight tuberculosis of peritoneum, lungs, kidneys, and uterus.
		927	1,250	1.0	"	82 days	Slight tuberculosis of peritoneum, lungs, kidneys, and uterus.

VIRUS H. 17. "Sp.B."—*continued*.

INJECTIONS OF RABBITS; MADE TO DETERMINE WHETHER THE VIRUS CONTAINS A STRAIN OF BACILLI, BELONGING TO GROUP II., AND CAPABLE OF BEING ISOLATED BY RAISING STRAINS FROM SINGLE COLONIES; BUT SHOWING INSTEAD A LOSS OF VIRULENCE OF THE STRAIN EVEN WHEN GROWN CONTINUOUSLY ON PURE SERUM.

CULTURE DERIVED FROM CALF 539 [THIRD PASSAGE], THROUGH RABBIT 181.

Separation of Colonies on a Glycerin-Serum Medium.

Cultures 3 weeks old. Rabbits inoculated intraperitoneally.

Generation and Source of Culture.	Length of time during which the strain has been in artificial cultivation.	Medium on which final culture was grown.	Dose in Milli-grammes.	Number of Rabbit.	Killed or Died.	Duration of Life.	Result.
Culture derived from <i>large wrinkled colony</i> on a glycerin-serum tube of 28-11-05.	15½ months	Pure serum	10·0	795	Died	95 days	Chronic progressive tuberculosis.
			10·0	796	Killed	166 days	Slight tuberculous peritonitis. Chronic tuberculosis of lungs and kidneys, the former rather severe.
			1·0	797	"	166 days	Slight tuberculosis of peritoneum and kidneys.
			1·0	798	"	166 days	Slight tuberculosis of peritoneum and kidneys. (Injection partly subcutaneous.)
" "	16 months	Pure serum	10·0	800	Killed	92 days	Chronic fibrous tuberculosis of peritoneum, lungs, and kidneys.
			10·0	801	Died	36 days	Slight tuberculous peritonitis. Tuberculosis of lung. Trace in kidneys.
			1·0	802	Killed	92 days	Abscess at seat of inoculation. A few fibrous tubercles in lungs. Injection intramuscular.
			1·0	803	"	92 days	Slight tuberculosis of lungs and peritoneum. Trace in kidneys.
Culture derived from <i>small colony</i> on a glycerin - serum tube of 28-11-05.	16½ months	Pure serum	1·0	828	"	37 days	Slight chronic tuberculosis of peritoneum, lungs, and kidneys. (Injection partly intracæcal.)
			0·1	829	"	145 days	Trace of tuberculosis in peritoneum only.

Serum Series. [Controls.]

Culture 3 weeks old. Rabbits inoculated intraperitoneally.

10th generation of culture on pure serum.	16 months	Pure serum	1·0	804	Killed	52 days	Slight chronic tuberculosis of peritoneum and lungs. Uterus filled with tuberculous deposit.
			1·0	805	"	92 days	Slight tuberculosis in peritoneum, lungs, and kidneys; very retrogressive in the former.

MODIFICATION OF THE VIRULENCE OF THE VIRUS H. 13. "A.D."

The third instance of apparent modification occurred in the case of Virus H. 13. "A.D." This came from a male child, aged four years, who died on June 6, 1903, of meningitis and miliary tuberculosis, affecting the lungs, liver, and spleen. The mesenteric glands were normal, but the bronchial glands were caseous, and were almost certainly the seat of the oldest lesion which was found after death. The largest, which measured 1 by $\frac{3}{4}$ in., contained caseating nodules, one of which had already broken down into grey purulent matter. Two other bronchial glands, which were whitish, opaque, and rather dense, contained caseating foci. There were numerous tubercle bacilli seen in a preparation from one of these glands. An emulsion was made from the gland most affected, and from the most affected portions of the two other bronchial glands, and since this did not seem sufficient for the purpose there was added two or three grammes of spleen. It was not very rich in tubercle bacilli, only 1,600 tubercle bacilli per cubic centimetre being estimated.

Two calves, Nos. 119 and 129, were injected subcutaneously with 10 cc. of this emulsion, on June 7, 1903. The estimated dose, 16,000 bacilli, has been shown by other experiments to be too small to produce general tuberculosis with certainty in the calf, even if the virus be virulent for this species of animal (see Appendix to 2nd Interim Report, Vol. II, page 1035). Therefore, the fact that in the cases now under consideration, minimal lesions, which did not spread beyond the nearest lymphatic glands, were found when the animals were killed some 9 or 10 weeks later, cannot be accepted as conclusive evidence that the virus was not virulent for the calf, and belonged to our Group II. Unfortunately, no rabbits were inoculated at this stage of the experiment.

Another calf, however, was subcutaneously injected with a larger dose of bacilli contained in an emulsion made from the calcareous prescapular gland of Calf 119, the estimated number of bacilli injected in this case being about 3,500,000. The result was even less than in the former calves, for when the animal was killed 89 days later there was only a pea-sized calcareous nodule at the seat of inoculation, and no tuberculosis elsewhere.

Even in this case the dose was not large enough to be quite satisfactory. Nevertheless there has occurred no instance in our experience where a virus of Group I. has produced a local lesion only, however small the dose; and in many cases general tuberculosis has been caused by injection of far smaller quantities of tubercle bacilli than were used in this case. The nearest approach to this result which has been produced here by a virus of Group I. was afforded by Calf 223 (H. 20. "F.L."), in which a dose of 2,300,000 bacilli produced minimal calcareous lesions which did not spread beyond the nearest lymphatic glands. This calf, however, was nearly twice as large as No. 225.* It cannot be maintained that the virulence may have deteriorated while the virus was subsisting in a calcareous lesion in a resistant animal, for our experience here affords striking evidence to the contrary.†

It must therefore be held that the virus "A.D." at this stage had a low degree of virulence for the calf, and consequently that it belonged to our Group II. At a later stage it developed high virulence for this animal. The steps by which this modification occurred were as follows:

When Calf 129, one of the two animals injected with the emulsion of human tissue, was killed on August 12, 1903, the lesions found in it were so small that there was very little tuberculous material available for the injection of other animals. The virus was accordingly passed through guinea-pigs with the object of obtaining larger quantities of tubercle bacilli. Three sets of guinea-pigs were injected in succession, and from the tuberculous organs of the last of these an emulsion was made containing over 27,000,000 tubercle bacilli per cubic centimetre. This was injected in doses of 20 cc. (541,300,000 bacilli), into Calves 299 and 301.

In the case of No. 299 the injection was intraperitoneal. In spite of the size of the dose the animal remained well, and when killed 87 days after injection, the disease was found to be limited to the peritoneum and to a few lymphatic glands. It was nowhere severe, and none of the great organs were affected. Even allowing that this may have been a highly resistant individual, it is certain that the virus had not yet attained to the virulence of those belonging to our Group I.‡

The virus, however, at this stage had attained a virulence for the calf far in excess of that of a member of Group II, for the calf, No. 301, which was injected subcutaneously, developed severe miliary tuberculosis, and was very ill when killed 33 days after injection. A rabbit injected with the same emulsion died of general tuberculosis in 24 days.

In contrasting Calf 301 with No. 299, it seems probable that it had a very low degree of individual resisting power.

From the posterior thoracic gland of Calf 301, an emulsion rich in tubercle bacilli was made and injected subcutaneously into three calves.

No. 315 received a dose estimated to contain 15,000 bacilli, which was intended to be approximately the same, or a little smaller than that given to the original pair of calves. It produced only small lesions at the seat of inoculation and in the nearest lymphatic glands, and although there were one or two minute tubercles in the thoracic glands, and one or two also in the lungs, liver, and spleen, such lesions have been produced by many of our Group II. viruses, and it cannot be maintained that this animal affords any certain proof of increase of virulence. This, however, is not the case with the two other calves injected at the same time.

No. 321 received a dose estimated to contain 3,500,000 tubercle bacilli, the same number as was contained in the dose given to No. 225. The calf rapidly developed severe general tuberculosis, and was very ill when killed 63 days after injection.

Calf 325, which received a dose estimated to contain 500,000,000 tubercle bacilli, which was slightly smaller than the number injected into No. 301, developed very acute miliary tuberculosis, and was in a dying state when killed 24 days after the injection. Rabbits injected with the same emulsion also died of general tuberculosis.

We may conclude from these results that at this stage the virus possessed all the virulence for the bovine and rabbit species of the viruses belonging to Group I. The fact that No. 315 did not develop general tuberculosis is not in conflict with this conclusion, because, as already stated, even typical viruses of Group I. cannot be relied upon to produce general tuberculosis with this dose.

To sum up these results, we may say that the virus derived from a case of meningitis and general tuberculosis in a young child, which probably arose in a bronchial gland, possessed, in all probability, when first tested on bovine animals, a low degree of virulence for them characteristic of our Group II. It is not possible to make a more definite statement, because the doses used at this stage of the experiment were too small. It is more certain that after the virus had passed through a series of three guinea-pigs and a calf its virulence for the ox species had become greatly augmented, and that it then possessed the high bovine virulence characteristic of our viruses of Group I., and that at an intermediate stage, when it was injected into Calf 301, its virulence was notably higher than that of viruses of Group II., but had not yet reached the standard of a virus of Group I.

CULTURE INJECTIONS.

Unfortunately, no cultures were obtained either directly or indirectly from the human material, nor from the calves which were injected in the earlier stages of the experiment. The first culture obtained was sown from the posterior thoracic gland of Calf 301. It was eugonic. Its virulence was not tested

* It is quite possible that the "F.L." virus, when it was injected into Calf 223, that is when it first came from man, had not the full degree of bovine virulence which it afterwards attained; in other words, that "F.L." affords another instance of modification.

† See Calf 223 (H. 20, "F.L."). Calf 797 (H. 49, "T.C."). Heifer 11 (H. 2, "Sp.A."). Bull Calf 35 (H. 10, "B.S.").

‡ For the effect of injecting a virus of Group II. into the peritoneal cavity, see Calf 309 (H. 11, "E.D.").

until after it had been fifteen months in artificial culture on bovine serum. At this period it was injected in 50 mg. doses into two calves, and also into rabbits.

Calf 761 developed a tumour at the seat of inoculation, consisting of a fibrous walled cyst with softened caseous contents. The nearest prescapular gland contained a large caseous nodule, and this also was softened. These lesions are characteristic of viruses of Group II. There were, however, in the lungs some small lesions slightly more severe than those commonly produced by viruses of Group II. These consisted of about a dozen pea-sized fibrous nodules with large irregular caseating nuclei. One of these nodules was $\frac{1}{2}$ in. in diameter, and there were also smaller tubercles, each with a caseous centre. It is in the existence of this central caseation as well as in their size, that these lesions differ from those sometimes produced by viruses of Group II.

A corresponding calf, No. 765, developed minimal lesions which did not extend beyond the nearest lymphatic glands. The rabbits also developed minimal lesions.

Thus if the virulence at this stage differed at all from that of a virus of Group II., the difference was slight only. The virulence must undoubtedly have

been higher fifteen months earlier when the virus existed in the body of Calf 301, which suffered from acute general tuberculosis. This conclusion is supported by the fact that an emulsion of the thoracic gland of this animal produced general tuberculosis when injected into a rabbit. We are therefore bound to conclude that this strain was once virulent for rabbits and calves, and that its virulence was unstable, and disappeared during the course of fifteen months' cultivation on artificial media. A parallel instability of virulence has already been described in one strain obtained in each of the two previously described modification experiments.

To return to the virus "A.D." A second culture obtained from Calf 321, injected in a dose of 50 mg. into Calf 825, provoked acute miliary tuberculosis, which proved fatal in 25 days, thus confirming the opinion already expressed, that in the final stage of the passage experiment the virus had attained the high bovine virulence characteristic of our Group I. Injected in 10 milligramme doses into Calves 821 and 823, it produced severe tuberculosis fatal in 50 days in one, and slight tuberculosis only in the other.

This culture was distinctly dysgonic, and showed as much reluctance to grow on glycerin media as any of our viruses of Group I.

CALVES INJECTED WITH THE VIRUS H. 13. "A.D."

I.—Tissue Emulsions.

—	Number of Animal.	Mode of Injection.	Estimated dose of Tubercle Bacilli.	Fate of Animal and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
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CALVES INJECTED WITH EMULSION OF HUMAN BRONCHIAL GLANDS.

—	Calf 119	S.	16,000	Killed when well after 67 days.	Local tuberculosis.
—	Calf 129	S.	16,000	Killed when well after 66 days.	Local tuberculosis.

CALVES INJECTED WITH THE VIRUS DESCENDED FROM CALF 129.

1st Passage ...	Calf 299	P.	541,333,000	Killed when well after 87 days.	Slight tuberculosis.
	Calf 301	S.	541,333,000	Killed when very ill after 33 days.	General tuberculosis, severe.
2nd Passage...	Calf 315	S.	15,000	Killed when well after 70 days.	Slight tuberculosis.
	Calf 321	S.	3,500,000	Killed when very ill after 63 days.	General tuberculosis, severe.
	Calf 325	S.	500,000,000	Killed when dying after 24 days.	General tuberculosis, severe.

CALF INJECTED WITH THE VIRUS DESCENDED FROM CALF 119.

1st Passage ...	Calf 225	S.	3,400,000	Killed when well after 89 days.	Local tuberculosis.
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S = Subcutaneous.

P = Intraperitoneal.

RABBITS INJECTED WITH THE VIRUS H. 13. "A.D."†

I.—Tissue Emulsions.

Source of Material used for Injection.	Number of Rabbit.	Estimated dose of Tubercle Bacilli.	Killed or Died.	Duration of Life in Days.	Result.
Guinea-pigs 905-907. (Third series from Calf 129.)	28	135,330,000	Died	24	General tuberculosis.
	29	"	"	12 (Subcutaneous).	No tuberculosis.
Calf 301 ... (Thoracic gland.)	37	99,332,000	"	87	General tuberculosis.
	38	37,000,000	"	18 (Intravenous).	Lungs solid. Tubercle bacilli swarming in all organs.
Calf 301. (Through Rat 15.)	107	"	"	16	Tuberculosis of peritoneum. Tubercle bacilli in organs.

† All injections were intraperitoneal, except where otherwise mentioned.

CALVES INJECTED WITH THE VIRUS H. 13. "A.D."

II.—Cultures.

—	Immediate Source of Culture.	Total Duration of Cultivation.	Number of Calf.	Weight in Kilos.	Fate of Animal and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
A.—DOSE : 50 MILLIGRAMMES. <i>Subcutaneous.</i>						
1st Passage ...	Calf 301	15 months	761	62.58	Killed when well after 90 days.	General tuberculosis, slight.
"	"	"	765	65.75	Killed when well after 91 days.	Local tuberculosis.
2nd Passage...	Calf 321	15½ months	825	44.44	Died after 25 days.	General tuberculosis, severe.
B.—DOSE : 10 MILLIGRAMMES. <i>Subcutaneous.</i>						
1st Passage ...	—	—	—	—	—	—
2nd Passage...	Calf 321	15½ months	821	41.27	Dying after 50 days.	General tuberculosis, severe.
"	"	"	823	43.54	Killed when well after 90 days.	Slight tuberculosis.

RABBITS INJECTED WITH THE VIRUS H. 13. "A.D."

II.—Cultures.

—	Immediate Source of Culture.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.	Killed or Died.	Duration of Life in Days.	Result.
A.—DOSE : 10 MILLIGRAMMES. <i>Intraperitoneal.</i>							
1st Passage ...	Calf 301	15 months	372	1,070	Killed	90	Slight tuberculosis of lung, peritoneum, and kidneys, ? liver. (Injection ? intracæcal.)
2nd Passage...	Calf 321	15½ months	518	1,240	Died	132	Chronic tuberculosis. (Injection intracæcal.)
B.—DOSE : 1 MILLIGRAMME. <i>Intraperitoneal.</i>							
1st Passage ...	Calf 301	15 months	373	800	Killed	90	Chronic general tuberculosis.
2nd Passage...	Calf 321	15½ months	519	1,220	Died	33	General tuberculosis.
"	"	"	520	1,200	"	36	General tuberculosis.
"	"	24 months	856	660	"	17	General tuberculosis.
"	"	"	857	630	"	19	General tuberculosis.

The hypothesis that one was dealing with a mixture of bacilli belonging to Groups I. and II. was tested in this case as was done in the case of the first modification experiment. The first virulent culture, namely that from Calf 321, was grown for several generations on glycerin serum, a method which, as already stated, has sometimes been successful in eliminating the virulent (dysgonic) element from an artificial mixture. In this case the strain was grown for six generations

during ten months and finally on pure serum. A parallel series of cultures was kept up on pure serum. When the final test was made the strain was two years old. Both series of culture proved to be fully virulent for rabbits.

The result of these experiments lent no support to the hypothesis that we had to deal with a mixture of bacilli of Groups I. and II.

INJECTION OF RABBITS; MADE TO DETERMINE WHETHER THE VIRUS CONTAINED A STRAIN OF BACILLI, BELONGING TO GROUP II., AND CAPABLE OF BEING ISOLATED BY MEANS WHICH PROVED SUCCESSFUL IN SEPARATING AN ARTIFICIAL MIXTURE OF GROUPS I. AND II., NAMELY, GROWTH ON GLYCERIN MEDIA.

CULTURES DERIVED FROM CALF 321, DIRECT [SECOND PASSAGE].

Glycerin-Serum Series.

Cultures 3 weeks old. Rabbits inoculated intraperitoneally.

Generation of Culture.	Length of time during which strain has been in artificial cultivation.	Medium on which final culture was grown.	Dose in Milligrammes.	Number of Rabbit.	Killed or Died.	Duration of Life in Days.	Result.
16th [After 6 on glycerin serum].	2 years in all [10 months on glycerin serum].	Pure serum	10.0	852	Died	15 days	General tuberculosis.
			10.0	853	"	12 days	Early general tuberculosis.
			1.0	854	"	21 days	General tuberculosis.
			1.0	855	"	21 days	General tuberculosis.

Serum Series. [Controls.]

Cultures 3 weeks old. Rabbits inoculated intraperitoneally.

14th on pure serum.	2 years	Pure serum	1.0	856	Died	17 days	General tuberculosis.
			1.0	857	"	19 days	General tuberculosis.

MODIFICATION OF VIRULENCE OF THE VIRUS H. 49. "T.C."

In the hitherto described instances the modification has been complete, that is to say, the viruses had at the start the low degree of bovine virulence characteristic of Group II., and they ended with the high degree of bovine virulence characteristic of Group I.

In the case now about to be described the original virulence at first fell only a little short of the virulence of Group I., and it gained the full virulence characteristic of this class after a *single* passage through a calf.

The case presents several points of interest. It is the only one* in which the original virulence (for ox and rabbit) of a virus obtained from man was in any sense intermediate between our Groups I. and II. As already stated it was much nearer Group I. than Group II. And of all the viruses which were virulent for the ox and rabbit it was the only one which came from an adult. The fact that the least virulent of the virulent viruses came from the oldest patient, in whom, moreover, the disease was of long standing, may be taken as evidence that the bacillus of Group I. becomes modified in the direction of Group II. by residence in man.

If this kind of modification can be established, it supports strongly the evidence of the contrary kind of modification, namely, that of Group II. into Group I. in the ox.

T.C. was a youth who died at the age of eighteen of tuberculosis of the lungs. There were small cavities in those organs, but there was evidently much older disease in the mesenteric glands, one of which was nearly as hard as stone.

Unfortunately no strain of tubercle bacilli was obtained from the lung. All the animals injected

with an emulsion made from it died of some acute infection; but a strain of culture was obtained directly from the mesenteric glands. This strain was injected when only two months old in doses of 50 mg. of bacilli into two calves.

One of these, No. 787, died 81 days after injection of severe tuberculosis of the lungs, with a few small tubercles in other organs. The other, No. 797, killed after 83 days, had only small lesions near the seat of inoculation, and a few little tubercles in the lungs and thoracic glands.

Even allowing that this animal was a highly resistant individual it cannot be doubted that this result indicates a degree of virulence which is distinctly below the standard of Group I. The only instance in which 50 milligrammes of a true Group I. virus failed to produce fatal tuberculosis within three months occurred in the case of Calf 667, H. 10. "B.S.," and in this animal the lesions were far more severe and very widespread.

But in order to leave no doubt as to the degree of virulence of the virus at this stage four additional calves were subcutaneously injected with a culture of the same strain, on November 3, 1905, two receiving 50 milligrammes and two 10 milligrammes. The former pair, Nos. 957 and 959, died in 61 and 53 days respectively of general tuberculosis. This is distinctly longer than the usual duration of illness after 50 milligrammes of a virus of Group I., and therefore afford additional evidence of the failure of the virus at this stage to reach the standard of that group. Of the two animals which were injected with 10 milligrammes, No. 953 died of general tuberculosis after 108 days, and No. 945 was killed when in good health after 96 days, and showed, in addition to a

* Except the lupus virus H. 53. "D.H." and possibly H. 20. "F.L."

local lesion, and tuberculosis of the nearest lymphatic glands, only a few small lesions scattered in the lungs, liver, spleen, and in the thoracic and portal glands. That these results indicate that the virulence for the calf was not quite up to the standard of Group I., can be best seen by referring to the diagram* which sets out the duration of life of calves which received subcutaneous injections of 50 and 10 milligrammes of culture of Group I. viruses. The four calves above mentioned are placed in this table for comparison.

Stronger evidence that the virulence of the virus was not up to the standard of Group I. was afforded by the injection of rabbits. These animals died of tuberculosis, but after a disease which was protracted decidedly beyond the usual limits. Thus even 50 milligrammes injected intraperitoneally proved fatal only in 39 days, 10 milligrammes in 69 and 35 days respectively, 1 milligramme in 87, 59, and 88 days respectively, and 0.1 milligrammes in 79 and 60 days respectively. The unusual slowness with which the disease in these cases approached a fatal termination can be best appreciated on reference to the table of culture injections into rabbits.†

These injections of calves and rabbits indicate, I think, sufficiently clearly that the virus H. 49. "T.C." when first obtained from man had a degree of virulence for these animals which approximated to, but fell somewhat short of, the standard of viruses of Group I.

Full bovine virulence was, however, obtained by passage through a single calf.

From the prescapular gland of No. 797, the calf which was the least affected of those which were injected with culture from the original material, a culture was made, and this was injected subcutaneously into four calves, two receiving 50 milligrammes and two 10 milligrammes.

All four suffered from very acute and fatal general tuberculosis. Nos. 931 and 949 (50 milligrammes) died in 21 and 39 days respectively, and Nos. 929 and 933, which received 10 milligrammes, died one in 39 days and the other actually earlier than either of the 50 milligramme calves, namely, in 19 days.

That this was a real increase of virulence I think cannot be denied. The rabbits also, injected at the same time as the calves just mentioned, gave similar results. All died very rapidly of general tuberculosis, in a much shorter time than those which received corresponding doses of the culture obtained direct from the human mesenteric glands.

The experiment with this virus therefore falls to some extent into line with the modification experiments previously described. In them the original virulence for calves and rabbits was that of an

ordinary member of Group II. In this it was high for these animals, but not up to the standard of Group I. In all, the virulence eventually rose to the full standard of Group I. The patient from which the virus was obtained in this case was a young adult, the only one from whom a virus has been obtained which was originally virulent for calves and rabbits. In the mesenteric glands of this youth there was tuberculous disease of very old standing. He died of more recent tuberculosis of lung. Here then we seem to have got a case of mesenteric infection with a bovine tubercle bacillus, probably in childhood, and when the disease proved fatal the bacilli had already to some slight but definite extent lost their virulence for calves and rabbits; and full virulence was rapidly restored by passage through a calf.

It is much to be regretted that we failed to get a strain of tubercle bacilli from the lungs of this patient.

The virulence for calves and rabbits of the original strain disappeared under artificial culture, as the following experiments will show.

The strain cultivated from the human mesenteric glands had, as already stated, been tested on calves and rabbits and found virulent. These tests had been made when it had been two months under cultivation on pure serum. They were repeated when it had been growing for seven months; the strain was still virulent. It was then grown for three generations on glycerin serum, a control strain being kept up on pure serum. These cultures were tested when the strain had been nine months under artificial cultivation. The result was unexpected. Not only had the cultures of the glycerin series lost their virulence for the rabbit, but those of the control series on pure serum also.

About two months later the strain was again tested. From a culture grown for the first time on glycerin serum two strains were raised, one from a small colony and the other from a large colony; the former was grown again on pure serum, and the latter on glycerin serum [for the second time]. Finally pure serum cultures were sown from each and injected into rabbits. *Neither* culture proved virulent.

In order to leave no doubt about this unexpected loss of virulence the culture was again tested on Calf No. 1097 and three rabbits. The strain had then been thirteen and a half months under artificial cultivation, always on pure serum, and had reached its thirteenth subculture.

These animals were killed three months after injection, and only the minimal lesions, characteristic of an injection with a virus belonging to our Group II., were found.

SUMMARY.

These results may be summarised as follows. A strain of culture was raised from the mesenteric glands of a youth, the subject of mesenteric and pulmonary tuberculosis, the former being evidently of very long standing.

When first tested two months after isolation from man this strain of tubercle bacilli was virulent for calves and rabbits, and produced fatal tuberculosis in them. But the virulence for these animals was definitely below the standard of our Group I.

Passed through a single calf the virus at once reached this standard; and proved as rapidly fatal to calves and rabbits as any we have dealt with.

The same virus, however, lost its virulence for these

animals during artificial cultivation; and when tested nine and again thirteen months after isolation, it was found to possess then no more virulence for them than any virus belonging to our Group II.

Of these facts there is ample evidence, a sufficient number of animals having been injected on each occasion to eliminate any uncertainty which might arise in consequence of the known difference of susceptibility of different individual animals.

These results are of great interest, for they reveal a virus unstable in both directions; capable of being increased in virulence for the bovine species when passed through a calf, and of losing whatever virulence it possessed for these species during continued growth on artificial media.

* Appendix to 2nd Interim Report, Vol. II, page 1029.

† Appendix to 2nd Interim Report, Vol. II, page 1091.

CALVES INJECTED WITH THE VIRUS H. 49. "T.C."

Cultures.

[NO INJECTIONS WERE MADE WITH TISSUE EMULSIONS.]

—	Immediate Source of Culture.	Total Duration of Cultivation.	Number of Calf.	Weight in Kilos.	Fate of Animal and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
A.—DOSE: 50 MILLIGRAMMES. <i>Subcutaneous.</i>						
—	Human mesenteric glands, direct.	2 months	787	44.90	Died after 81 days.	General tuberculosis, moderate.
—	"	"	797	44.90	Killed when well after 83 days.	Slight tuberculosis.
—	"	7 months	957	44.90	Died after 61 days.	General tuberculosis, severe.
—	"	"	959	42.18	Died after 53 days.	General tuberculosis, severe.
1st Passage	Calf 797	2 months	931	56.24	Died after 21 days.	General tuberculosis, severe.
	"	"	949	52.61	Died after 39 days.	General tuberculosis, severe.
B.—DOSE: 10 MILLIGRAMMES. <i>Subcutaneous.</i>						
—	Human mesenteric glands, direct.	2 months	929	47.60	Dying after 39 days.	General tuberculosis, severe.
	"	"	933	52.16	Died after 19 days.	General tuberculosis, moderate.

RABBITS INJECTED WITH THE VIRUS H. 49. "T.C."

Cultures.

—	Immediate Source of Culture.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.	Killed or Died.	Duration of Life in Days.	Result.
A.—DOSE: 50 MILLIGRAMMES. <i>Intraperitoneal.</i>							
—	Human mesenteric glands, direct.	2 months	448	1,420	Died	39	Slight tuberculosis of peritoneum, lungs and kidneys.
1st Passage	—	—	—	—	—	—	—
B.—DOSE: 10 MILLIGRAMMES. <i>Intraperitoneal.</i>							
—	Human mesenteric glands, direct.	2 months	449	1,010	Died	69	General tuberculosis.
—	"	7 months	658	1,300	"	35	Tuberculosis of peritoneum. Slight tuberculosis of lungs and kidneys.
1st Passage	Calf 797	2 months	654	1,850	"	15	General tuberculosis, acute.
C.—DOSE: 1 MILLIGRAMME. <i>Intraperitoneal.</i>							
—	Human mesenteric glands, direct.	2 months	450	1,180	Died	87	Severe caseous tuberculosis of peritoneum and lungs. Slight tuberculosis of kidneys.
—	"	7 months	659	1,550	"	59	Tuberculosis of peritoneum, lungs and kidneys.
—	"	"	660	1,610	"	88	General tuberculosis.
1st Passage	Calf 797	2 months	655	1,910	"	21	General tuberculosis.
—	"	"	656	1,470	"	21	General tuberculosis.

RABBITS INJECTED WITH THE VIRUS H. 49. "T.C."—*continued*.CULTURES—*continued*.D.—DOSE: 0·1 MILLIGRAMME. *Intraperitoneal*.

—	Immediate Source of Culture.	Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.	Killed or Died.	Duration of Life in Days.	Result.
—	Human mesenteric glands, direct.	2 months	451	1,260	Died	79	Slight tuberculosis of peritoneum. Severe tuberculosis of lungs and kidneys.
—	"	7 months	661	1,230	"	60	General tuberculosis.
1st Passage	Calf 797	2 months	657	1,910	"	24	General tuberculosis.

INJECTIONS OF RABBITS SHOWING LOSS OF VIRULENCE AFTER CONTINUED CULTIVATION.

CULTURE DERIVED FROM HUMAN MESENTERIC GLANDS, DIRECT.

Glycerin-Serum Series.

Cultures 3 weeks old. Rabbits inoculated intraperitoneally.

—	Total Duration of Artificial Cultivation.	Medium on which Final Culture was Grown.	Dose in Mg.	Number of Rabbit.	Killed or Died.	Duration of Life.	Result.
9th generation of culture; after 3 on glycerin-serum.	9 months	Pure serum	5	758	Killed	121 days	No tuberculosis. Tubercle bacilli in a dead cysticercus.
			5	759	Died	25 days	Slight tuberculosis of peritoneum and kidneys.
			1	760	Killed	121 days	Death from other causes. Chronic tuberculosis of peritoneum. Trace in lungs and right kidney.

Serum Series.

Cultures 3 weeks old. Rabbits inoculated intraperitoneally.

8th generation of culture on pure serum.	9 months	Pure serum	1·0	757	Died	9 days	Early tuberculosis of peritoneum. Death due to psorospermiosis.
			1·0	761	Killed	121 days	Trace of tuberculosis in peritoneum and lungs.
			0·1	762	"	121 days	Trace of tuberculosis in peritoneum and lungs.

SEPARATION OF COLONIES ON A GLYCERIN-SERUM MEDIUM.

Cultures 3 weeks old. Rabbits inoculated intraperitoneally.

Eugonic strain from large colony on glycerin-serum culture of 28/11/05. 12th culture; on serum, after 2 generations on glycerin-serum.	11 months	Pure serum	10·0	781	Died	80 days	Minimal tuberculosis, supuration about head of eyes, and a few small retrogressive tubercles in lungs.
			5·0	782	"	16 days	Tuberculous peritonitis. Death from other causes.
			1·0	783	"	78 days	Slight tuberculosis of peritoneum and lungs. Trace in one kidney.
			1·0	784	Killed	105 days	Slight tuberculous peritonitis. Trace in one kidney.
Dysgonic strain from small colony on glycerin-serum culture of 28/11/05. 12th culture; on serum after 1 generation on glycerin-serum.	11 months	Pure serum	10·0	777	Killed	65 days	Chronic tuberculosis of peritoneum and lungs. Trace in one kidney.
			1·0	778	"	105 days	Chronic tuberculosis of peritoneum. Trace in lungs.
			1·0	779	"	105 days	Trace of tuberculosis in peritoneum and lungs.
			0·1	780	"	105 days	Chronic tuberculosis of lungs. Trace in peritoneum and one kidney.

VIRUS H. 49. "T.C."—*continued*.

LES SHOWING LOSS OF VIRULENCE FOR CALVES AND RABBITS OF THE STRAIN OF CULTURE DERIVED DIRECT FROM HUMAN MESENTERIC GLANDS, AFTER GROWTH FOR MANY GENERATIONS ON ARTIFICIAL MEDIA. (RE-ARRANGEMENT OF EXPERIMENTS IN PRECEDING TABLES).

Culture Medium Used: Pure Bovine Serum only.

A.—CALVES.

Total Duration of Cultivation.	Number of Calf.	Weight in Kilos.	Dose in Milligrammes.	Fate of Animal and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
(a) BEFORE LOSS OF VIRULENCE.					
2 months ...	787	44.90	50.0	Died after 81 days	General tuberculosis, moderate.
	797	44.90	50.0	Killed when well after 83 days.	Slight tuberculosis.
7 months ...	957	44.90	50.0	Died after 61 days	General tuberculosis, severe.
	959	42.18	50.0	Died after 53 days	General tuberculosis, severe.
(b) AFTER LOSS OF VIRULENCE.					
14 months ...	1097	54.42	50.0	Killed when well after 89 days.	Slight tuberculosis.

B.—RABBITS.

Total Duration of Cultivation.	Number of Rabbit.	Weight in Grammes.	Dose in Milligrammes.	Killed or Died.	Duration of Life.	Result.
(a) BEFORE LOSS OF VIRULENCE.						
2 months ...	448	1,420	50.0	Died	39 days	Slight tuberculosis of peritoneum, lungs and kidneys.
	449	1,010	10.0	"	69 days	General tuberculosis.
	450	1,180	1.0	"	87 days	Severe caseous tuberculosis of peritoneum and lungs. Slight tuberculosis of kidneys.
	451	1,260	0.1	"	79 days	Slight tuberculous peritonitis. Severe tuberculosis of lungs and kidneys.
7 months ...	658	1,300	10.0	"	35 days	Tuberculous peritonitis. Slight tuberculosis of lungs and kidneys.
	659	1,550	1.0	"	59 days	Tuberculosis of peritoneum, lungs and kidneys.
	660	1,610	1.0	"	88 days	General tuberculosis.
	661	1,230	0.1	"	60 days	General tuberculosis.
(b) AFTER LOSS OF VIRULENCE.						
3 months ...	761	1,100	1.0	Killed	121 days	Trace of tuberculosis in peritoneum and lungs.
	762	1,100	0.1	"	121 days	Trace of tuberculosis in peritoneum and lungs.
11 months ...	777	1,500	10.0	"	65 days	Chronic tuberculosis of peritoneum and lungs. Trace in one kidney.
	778	1,700	1.0	"	105 days	Chronic tuberculosis of peritoneum. Trace in lungs.
	779	1,550	1.0	"	105 days	Trace of tuberculosis in peritoneum and lungs.
	780	1,690	0.1	"	105 days	Chronic tuberculosis of lungs. Trace in peritoneum and one kidney.
14 months ...	904	800	10.0	"	89 days	Slight tuberculosis of omentum and kidneys.
	905	700	10.0	"	89 days	Trace of tuberculosis in omentum only.
	906	750	1.0	"	89 days	Slight tuberculosis of omentum and kidneys.

MODIFICATION OF THE VIRULENCE OF THE VIRUS H. 21. "G.B."

"G.B.," aged sixteen years, died on December 1, 1903, of heart disease and pericarditis. Tuberculous bronchial glands were discovered at the post-mortem examination. They consisted of eight or ten pigmented and congested glands of the size of haricot beans, and most of them showed on section a number of minute grey tubercles. There was no tuberculosis elsewhere.

An emulsion was made of these glands, and injected subcutaneously into calves. It was not very rich in tubercle bacilli, and the 10 cc. of emulsion injected into each was estimated to contain 156,000 tubercle bacilli only. One of these calves, No. 285, was killed after 91 days, and no tuberculous lesions were found, not even at the seat of inoculation or in the glands nearest to it. A week before death the animal was tested with tuberculin, and did not react. The other calf, No. 279, which received the same dose was killed also three months after injection, and there was found at the seat of inoculation a small tumour which had undergone softening, several groups of calcareous grains in the nearest prescapular gland, and three small pinhead translucent tubercles in the spleen. Thus far the lesions caused by this virus in calves were minimal. Rabbits injected at the same time as the calves above mentioned also developed minimal lesions.

The dose given to the calves had been small. It was therefore decided to inject another pair with larger numbers of tubercle bacilli. For this purpose guinea-pigs were injected with an emulsion of the prescapular gland of Calf 279, and from these guinea-pigs other guinea-pigs were injected, and an emulsion was made from their organs and injected subcutaneously into Calves 433 and 447. The emulsion which was rich in tubercle bacilli, was estimated to contain nearly 240,000,000 per cc., and since the volume of the emulsion injected was 20 cc., the number of tubercle bacilli in each dose was very large, namely, nearly 5,000,000,000.

Both calves were killed four months after injection. No. 433 had minimal lesions only, consisting of a small fibro-calcareous lesion at the seat of inoculation, and several little groups of calcareous grains in the nearest prescapular gland.

In No. 447 the lesion at the seat of inoculation was a little more extensive, and there were some calcareous grains in the nearest prepectoral, the thoracic, and one popliteal gland. But in addition to these there were in the lungs one or more small lesions which were of considerable importance, as will appear in the sequel, and therefore they will be described fully.

In the posterior lobe of the left lung was a tubercle about $\frac{1}{8}$ in. or a little more in diameter, reddish in colour, with a grey centre. Two other similar, but rather smaller tubercles were found, one in each lung. In the posterior lobe of the right lung, about 3 in. from the bifurcation of the tracheæ, and lying on the inner side of the main bronchus, buried in the lung tissue, was a hard nodule measuring 1 in. by $\frac{3}{4}$ in. by $\frac{1}{2}$ in., which was fibrous and very calcareous on section. It shelled out of the lung quite readily, having a smooth surface, and it was thought that it might have developed in a peribronchial gland, though not quite in the normal situation.

On the anterior and external surface of the root of the right bronchus, close to the bronchus leading to the third lobe, was a slightly enlarged peribronchial gland $\frac{3}{4}$ in. in length. It was firmer than usual, but presented no definite sign of tubercle.

In the posterior thoracic gland, besides the calcareous foci already mentioned, there was a nodule the size of a small gooseberry, full of calcareous grains.

In view of the importance which afterwards came to be attached to these pulmonary lesions, it will be well to show the impression which they made upon one's mind at the time, before any modification of virulence was known to have taken place, and before any question had arisen as to the interpretation of that modification. I will therefore quote *in extenso* a comment written at the time upon the post-mortem examinations of these two calves. It must be under-

stood that this was based entirely on anatomical evidence.

COMMENT ON CALVES 447 AND 433.

"The dose was one of the largest given, namely, 4,797,600,000 tubercle bacilli. Both calves had a rise of temperature to nearly 41° in the third week. In 433 it soon began to fall, and reached the normal in about five weeks from the day of inoculation. In Calf 447 it remained between 39° and 40° until nearly eight weeks from the day of injection.

"Both animals shortly before they were killed appeared perfectly well and each gave one rather poor tuberculin reaction, but a repetition of the tuberculin injection, and even doubling the dose, gave a complete negative. Thus there is reason to think that in neither animal was the disease progressing at the time it was killed.

"The larger lesion in the lung of Calf 447 was obviously an old one; the three little tubercles appeared more recent. The larger lesion was quite unexpected and unlike anything found in a similar case before. It might be thought possibly due to an independent infection, but the original tuberculin test of this animal was quite satisfactory."

CULTURE INJECTIONS WITH THE "G.B." VIRUS.

Three strains of tubercle bacilli were raised in culture from Calf 447, namely:—

- A. From the thoracic gland, direct.
- B. From the prescapular gland through a guinea-pig, No. 1417.
- C. From the prescapular gland through a rabbit, No. 155.

This rabbit, when killed six months after injection, was found to have slight tuberculosis, rather widely distributed, not precisely of the average type produced by bacilli of Group II.

Its fellow, No. 156, had developed lesions characteristic of bacilli of Group II.

These three cultures from Calf 447 were eugonic. Their virulence was tested on rabbits and calves with the following results:

The culture from Rabbit 155 was tested, after it had been six weeks under artificial cultivation, on rabbits only. It produced in the usual doses minimal lesions. On the contrary, the cultures obtained direct from the thoracic gland of the calf, and from the prescapular gland through Guinea-pig 1417, though equally eugonic with the one obtained from the rabbit, unlike it, were virulent for calves and rabbits, the virulence being up to the standard (or nearly so) of the virulent viruses.

Thus the anomalous result was obtained that of three strains of tubercle bacilli derived from Calf 447, two were virulent for calves and rabbits, while the other was non-virulent for rabbits—it was not then tested on calves—both a virulent and a non-virulent (for rabbits) strain being obtained from the calf's prescapular gland. All these strains were eugonic, in this respect differing from the virulent strains obtained in the other modification experiments.

Remembering that in each of the other experiments from which modification resulted, there was evidence that the strains of bacilli derived from the first animals to develop tuberculosis were unstable in virulence, it will be asked what was the total duration of cultivation of each of these strains when their virulence was tested; and whether the differences of virulence is explicable by differences of age. The strains which proved virulent to calves and rabbits were tested after four and seven and a half months artificial cultivation on pure serum respectively, and that which proved non-virulent to rabbits was tested after six weeks' cultivation on the same medium. But in addition the two virulent strains were tested again on rabbits after eleven and eighteen

months' growth on serum respectively, and their virulence was found to be unimpaired.

While these strains, unlike the unstable strains from the other modification experiments, retained their virulence for the rabbit when grown for long periods of time on pure serum, they lost this virulence quickly when grown on media containing glycerin.

It will be remembered that repeated cultivation on this medium, which favours eugonic at the expense of dysgonic bacilli, was successful in eliminating the virulent element from an artificial mixture of virulent and non-virulent bacilli, and from a strain derived from a rabbit injected with such a mixture (*see page 345*). The same method was successful with one of the virulent strains now under consideration. The other was sown once on glycerin-serum, sparsely, and from a single eugonic colony of this culture a strain was raised which was not virulent for rabbits. An attempt was made to pick out a dysgonic colony and from it raise a dysgonic and virulent strain, but this was not successful.

The following are the details of these experiments :—

The virulent culture from the prescapular gland of Calf 447 through Guinea-pig 417, after growing for 5 generations on pure serum, was then grown for 4 generations on glycerin media, thus :

6th generation, sown April 17, 1905, on glycerin-agar.

7th generation, sown July 3, 1905, on glycerin-serum.

8th generation, sown July 24, 1905, on glycerin-serum.

9th generation, sown August 28, 1905, on glycerin-serum.

From the 4th culture on a glycerin medium, being the 9th culture in all, serum cultures were sown for the inoculation of rabbits.

As control, a culture sown from the 9th of a series on pure serum was used.

In both cases the actual cultures injected were 21 days old.

INJECTION OF RABBITS; MADE TO DETERMINE WHETHER THE VIRUS CONTAINED A STRAIN OF BACILLI, BELONGING TO GROUP II., AND CAPABLE OF BEING ISOLATED BY MEANS WHICH PROVED SUCCESSFUL IN SEPARATING AN ARTIFICIAL MIXTURE OF GROUPS I. AND II., NAMELY, GROWTH ON GLYCERIN MEDIA.

CULTURE DERIVED FROM THE PRESCAPULAR GLAND OF CALF 447, THROUGH GUINEA-PIG 1417.

Glycerin-Serum Series.

Culture 3 weeks old. Rabbits inoculated intraperitoneally.

Generation of Culture.	Total Duration of Artificial Cultivation.	Medium on which Final Culture was Grown.	Dose in Milligrammes.	Number of Rabbit.	Killed or Died.	Duration of Life.	Result.
10th. (After 4 on glycerin-serum.)	11 months	Pure serum	10.0	644	Killed	100 days	Slight tuberculosis of peritoneum, lungs, kidneys, and uterus.
			10.0	645	Died	50 days	Slight tuberculosis of peritoneum, lungs, and kidneys. Death due to cysticercosis.
			1.0	646	Killed	100 days	Very slight tuberculosis of lungs; trace in one kidney. Lesion in caecum. Injection largely intracæcal.
			1.0	647	"	100 days	Slight tuberculosis of peritoneum and lungs.

Serum Series. [Controls.]

Culture 3 weeks old. Rabbits inoculated intraperitoneally.

10th on pure serum.	11 months	Pure serum	1.0	648	Died	23 days	General tuberculosis.
			1.0	649	"	22 days	General tuberculosis.

These experiments show that the virus obtained from Calf 447, indirectly from the prescapular gland through Guinea-pig 1417, which was virulent for calves and rabbits as long as it was grown upon pure serum,

entirely lost its virulence for the rabbit (and presumably for the calf also) when grown for several generations on glycerin media, in this respect behaving like the artificial mixture H. 8 "S.C." and H. 10 "B.S."

CULTURE OBTAINED DIRECT FROM THE THORACIC GLAND OF CALF 447.

Successful Attempt to Separate a Strain belonging to Group II., by Cultivation from a Single Colony.

From the 11th culture on pure serum, a glycerin-serum culture was sown on November 28, 1905. On it two large cream coloured colonies appeared, and from one of these a strain was cultivated.

For control the 14th culture on pure serum, sown February 2, 1906, was used.

Separation of Colonies on a Glycerin-Serum Medium.

Culture 3 weeks old. Rabbits inoculated intraperitoneally.

Generation of Culture, &c.	Total Duration of Artificial Cultivation.	Medium on which Final Culture was Grown.	Dose in Milligrammes.	Number of Rabbit.	Killed or Died.	Duration of Life.	Result.
14th Generation. (Strain raised from a large colony on glycerin-serum culture of November 28, 1905.)	18 months	Pure serum	10.0	807	Died	23 days	Tuberculous peritonitis.*
			10.0	808	Killed	159 days	Trace of tuberculosis in omentum.
			1.0	809	"	159 days	Slight tuberculous peritonitis. Chronic tuberculosis of lungs, and kidneys (rather severe).
			1.0	810	"	159 days	Slight tuberculosis of peritoneum, lungs and kidneys.

Serum Series [Controls.]

Culture 3 weeks old. Rabbits inoculated intraperitoneally.

14th on pure serum.	18 months	Pure serum	1.0	811	Died	28 days	General tuberculosis.
			1.0	812	"	32 days	General tuberculosis.

This experiment shows that from the virulent strain derived directly from the thoracic gland of Calf 447, a strain which was not virulent for rabbits was obtained from a single colony.

* Occasionally an injection of a large quantity of bacilli of Group II into the peritoneal cavity of rabbits produces tuberculous peritonitis, which kills rather quickly. The fate of the other rabbits in this experiment clearly shows that the virus possessed the virulence of Group II.

CALVES INJECTED WITH THE VIRUS H. 21. "G.B."

[I.—Tissue Emulsions.

—	Number of Animal.	Mode of Inoculation.	Estimated dose of Tubercle Bacilli.	Fate of Animal and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
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CALVES INOCULATED WITH EMULSION OF HUMAN BRONCHIAL GLANDS.

—	Calf 285	S.	156,000	Killed when well after 91 days	Normal throughout.
—	Calf 279	S.	156,000	" " " 91 days	Slight tuberculosis.

CALVES INJECTED WITH THE VIRUS DESCENDED FROM CALF 279.

1st Passage	Calf 433	S.	4,797,600,000	Killed when well after 111 days	Local tuberculosis.
"	Calf 447	S.	4,797,600,000	" " " 111 days	Slight tuberculosis.

S = Subcutaneous.

RABBITS INJECTED WITH THE VIRUS H. 21. "G.B."

I.—Tissue Emulsions.†

Direct source of Tissue Emulsion used.	Number of Rabbit.	Estimated dose of Tubercle Bacilli.	Killed or Died.	Duration of Life in Days.	Result.
Human bronchial glands ...	20	16,000	Killed	97	Slight tuberculous peritonitis. Translucent tubercles in lungs.
" " "	21	16,000	"	97 (Subcutaneous)	Healthy.
Calf 447 (prescapular gland)	155	—	"	196	Slight tuberculosis rather widely distributed; not precisely of average type.
" " "	156	—	"	274	Tuberculosis of mammary gland, left kidney and lungs.

† All injections were intraperitoneal except where otherwise mentioned.

CALVES INJECTED WITH THE VIRUS H. 21. "G.B."

II.—Cultures.

DOSE: 50 MILLIGRAMMES. *Subcutaneous inoculations.*

—	Immediate Source of Culture.	Total Duration of Artificial Cultivation.	Number of Calf.	Weight in Kilos.	Fate of Animal and Condition at Death.	Amount and Range of Tuberculous Lesions at Death.
1st Passage	Thoracic gland of Calf 447, direct [Strain A].	7½ months	747	50·80	Dying after 24 days	General tuberculosis, severe.
	Prescapular gland of Calf 447 through Guinea-pig 1417 [Strain B].	4 months	665	43·99	Killed when well " 90 days	General tuberculosis, slight.
			669	43·54	Died " 55 days	General tuberculosis, severe.

RABBITS INJECTED WITH THE VIRUS H. 21. "G.B."

II.—Cultures.

Intraperitoneal inoculations.

—	Immediate Source of Culture.	Total Duration of Artificial Cultivation.	Dose in Milligrammes.	Number of Rabbit.	Weight in Grammes.	Killed or Died.	Duration of Life in Days.	Result.
1st Passage	Thoracic gland of Calf 447, direct. [Strain A.]	7½ months	10·0	395	1,300	Died	14	General tuberculosis.
			1·0	396	1,300	"	18	General tuberculosis.
			0·1	397	970	"	38	General tuberculosis.
			0·01	398	1,020	"	30	General tuberculosis.
" "	Prescapular gland of Calf 447, through Guinea-pig 1417. [Strain B.]	4 months	25·0	310	970	"	14	General tuberculosis, acute.
			2·5	311	1,170	"	19	General tuberculosis, acute.
		11 months	1·0	648	1,850	"	23	General tuberculosis.
			1·0	649	1,650	"	22	General tuberculosis.
" "	Prescapular gland of Calf 447, through Rabbit 155. [Strain C.]	1½ months	10·0	434	1,340	Killed	41	Slight tuberculosis of peritoneum and kidneys. Lungs congested, but no tubercle bacilli found in them.
			1·0	435	950	"	87	Slight chronic tuberculosis of lungs. Trace in peritoneum and kidneys.
			0·1	436	1,190	"	87	Slight chronic tuberculosis of lungs and kidneys. Trace in peritoneum.

SUMMARY OF THE MODIFICATION EXPERIMENTS.

It may be useful at this point to pass in review some of the principal features of these five modification experiments, and point out where they agree and where they differ.

In three of these experiments the virus was originally a typical member of our Group II.; it was eugonic, and possessed a very low degree of virulence for the calf and rabbit. In one the original strain was probably of this kind, but the proof is not complete. In the remaining case it was virulent for the calf and rabbit, but distinctly less so than a typical member of our Group I.

After passing through several calves, and in some cases guinea-pigs, the virus in each case came to possess the high degree of virulence for the calf and rabbit characteristic of the viruses belonging to our Group I. Except in the case of H. 21. "G.B.", the cultural characters of the virus in each case changed with the virulence and became ultimately very dysgonic.

In each of the five cases, H. 21. "G.B." again excepted, the strain derived directly or indirectly from the first calf which developed general tuberculosis was after a longer or shorter period of cultivation on pure serum found to have lost its virulence for the calf and rabbit. In some ("J.H." and "A.D.") the strain was not tested until it had already lived some months in artificial culture, and was then found to have this low degree of virulence for these species; in others ("T.C." and "Sp.B.") it was virulent when first tested and lost its virulence later.

In the case of the virus "G.B." three strains of bacilli were raised from the calf which was the first to develop more than the minimal lesions characteristic of an injection with a virus of our Group II. Of these two were virulent for the rabbit, and one non-virulent. These virulent strains retained their virulence for many months as long as they were grown on pure serum, but lost it as soon as they were grown several times on glycerin media, or when the strain was propagated from a single eugonic colony; thus behaving like an artificial mixture.

It ought to be mentioned at this point that the stability of virulence of many other strains of Group I. under artificial cultivation, both on media with and without glycerin, has been tested in a large number of cases and after long-continued cultivation, amounting in one case to over two years, and no appreciable modification has been detected in any of them.

On the other hand, when dealing with artificial mixtures of bacilli belonging to our Groups I. and II., or with strains derived from rabbits injected with these mixtures, it has been found possible to separate from these virulent and eugonic mixed strains the

element which is eugonic and non-virulent for calves and rabbits. This has been done by raising strains from single colonies which appeared on sparsely-sown glycerin-serum tubes, and also by the method of successive cultivations on glycerin media, which markedly favours the non-virulent eugonic strains at the expense of the virulent dysgonic strains. (See *Report, Experiments with Mixed Viruses*, page 345 of this Volume.)

These experiments gave us a method of testing strains of culture to see whether they contained different kinds of tubercle bacilli. The method has been applied to one or more of the strains raised in the course of each of our modification experiments. The results of these experiments was to afford no evidence of mixture except in the case of "G.B."; this strain, unlike all the others, behaving exactly like an artificial mixture of bacilli belonging to Groups I. and II. had done.

To recapitulate the principal points of difference between the results obtained from the virus "G.B.", and those with the other viruses which became modified. In each of our modification experiments a strain of bacilli of unstable virulence for the calf and rabbit was obtained.

In the case of four of the modification experiments the strain of culture referred to above proved unstable when grown *exclusively on pure serum*. In the case of "G.B." the strain in question proved unstable only when grown on *glycerin media*, and retained its virulence on pure serum. Moreover, a non-virulent strain was raised on pure serum from a single colony picked out from a culture sown on glycerin-serum for the first time.

Thus the case of "G.B." differs in several important particulars from the other four.

The main question which arises out of these experiments is whether we are dealing with a mixture of two distinct kinds of tubercle bacilli, and the subsequent elimination of one of them; or whether there occurred a true modification of one kind into the other.

The fact that the strain of tubercle bacilli obtained from Calf 447. "G.B." behaved when grown on glycerin media like mixtures of dysgonic virulent and eugonic virulent bacilli, very strongly supports the suspicion, first raised on purely anatomical grounds, that this calf suffered from a spontaneous infection.

And the facts that strains derived from comparable calves in the other modification experiments behaved differently supports the view that in them a true modification took place. The evidence, however, is not conclusive, and the question whether true modification of the common human type of tubercle bacillus (Group II.) into the common bovine type (Group I.) took place must remain at present undecided.

REPORT ON THE STABILITY OF VIRULENCE OF TUBERCLE BACILLI IN THE LIVING ANIMAL.

PART II.

FURTHER "PASSAGE EXPERIMENTS."

In the previous chapter certain "modification" experiments have been described, which having started with a virus which was eugonic and possessed a very low degree of virulence for the calf and rabbit, in other words a typical member of our second group, ended with a virus possessing a high degree of virulence for these animals, and which grew badly on glycerin media, in other words with a typical member of our Group I. In the present chapter similar experiments which ended otherwise are described.

This second series of modification experiments, that with the virus H. 8. "S.C." alone excepted, were done after the others, and under improved conditions. They differ from the preceding in the following particulars:—

- (1) Several of them commenced with cultures, instead of with fresh tissue emulsions, and
- (2) Except in the case of the experiments with the virus H. 8. "S.C." the calves were kept in stalls far removed from other animals infected with viruses of Group I.

In the earliest experiments it had not been possible to effect this separation, because at the time they were commenced, the virulence of the viruses employed had not then been determined.

These experiments may be considered under three headings.

- (1) Repetitions of the successful "passage" experiments, with the same viruses.
- (2) Intravenous "passage" experiments—similar to that with H. 17. "Sp. B." but with other viruses.
- (3) Rabbit "passage" experiments.

Charts are given showing the main facts of each experiment.

[1.] Repetition of the Successful "Passage" Experiment with the same Viruses.

(a) H. 16. "J.H." (See page 334.)

The intention was to repeat the original experiment as closely as possible, and therefore the method of injection was subcutaneous throughout. It was, however, no longer possible to begin with a tissue emulsion, and a culture had to be used instead. That from G.P. 609 which had been injected with an emulsion of the human joint tissue was chosen, and 50 mg. of bacilli from a three weeks' old growth was injected subcutaneously into Calf 527. The virus had then been fourteen months under artificial cultivation.

After ninety days the calf was killed. There was a small caseous abscess at the seat of inoculation, and a few calcareous foci in the prescapular gland.

With this unpromising material Calf 631 was injected, as large a dose as possible being used of an emulsion made from the prescapular gland, reinforced by part of the local lesion, and containing 5,000 million T.B. The animal was killed in 113 days, a small ulcer at the seat of inoculation, and some caseo-calcareous patches in the prescapular gland being the only lesions found.

A third calf, 753, was then injected with an emulsion of the prescapular gland of the last animal, containing fourteen million T.B. After ninety days the calf was killed, and a few calcareous grains only were found at the seat of injection, and one yellow focus in the prescapular gland. It was obviously useless to continue the experiment.

This experiment would have appeared more satis-

factory if the animals had been killed earlier; but it will be remembered that in the original H. 16. "J.H." passage experiment the first three animals were allowed to live sixty-seven, eighty-one, and eighty-nine days respectively.

The principal difference in the conditions of the two experiments seems to me to have been that the first started with a tissue emulsion, the virus never having been grown in culture, while the second began with a culture of a virus which had been growing for fourteen months on artificial media.

The question whether this may account for the difference in the result must be considered. On the hypothesis of the original virus being a mixture containing a very small trace of the bacilli of the virulent type, it is of course possible that after long continued cultivation the virulent element had died out. Thus in the first experiment the few virulent bacilli may be considered to have increased relatively to the less virulent by growing in the calf under conditions more suitable to the former, while in the latter experiment this could not take place, because the virulent element had already died out in culture. I do not wish to press this explanation unduly, but put it forward as one of the possibilities to be considered.

(b) Repetition of the H. 17. "Sp.B." Intravenous "Passage" Experiment. (See page 335.)

Here again one had to begin with a culture, that from Guinea-pig 1235 (the emulsion of whose organs formed the starting point of the first intravenous series) being used. It had at that time been growing for about eight months on artificial culture media. A growth three weeks old was used, and 10 milligrammes of bacilli were injected intravenously into Calf 685. At the same time two calves received 50 milligrammes each subcutaneously. These were to serve as controls.

The intravenous calf was killed sixty-four days later, a moderate number of little tubercles being found in the lung. None were present in the thoracic glands, which appeared to be normal. The two calves injected subcutaneously developed minimal lesions. An emulsion of the little tubercles in the lungs of Calf 685 was made, but as only three or four bacilli could be found in the microscopic preparation, it was thought useless to continue the experiment.

Accordingly it was repeated with a larger dose, the same strain now about eleven months in artificial cultivation being used, and 90 milligrammes of bacilli injected intravenously into a young bull, 607 (nine months old). This did not produce so severe a result as was expected; probably the age of the animal (it weighed about three times as much as the calves usually employed) accounted for its greater capacity for resistance. The animal was killed after 48 days. There was a small caseous mass just outside the wall of the vein at the seat of inoculation, indicating that the material injected had not all gone into the circulation. The lungs appeared slightly indurated, but no tubercles were found in them. A few small tubercles were seen in each kidney; all other organs appeared perfectly normal. No tubercle bacilli could be found in preparations from the lungs, thoracic glands, liver, or spleen, and only two in a film made from the kidney tubercles.

The paucity of infective material made it useless to continue this experiment.

It is not a satisfactory negative result; the dose in the first case being too small, and in the second having failed in part to reach the circulation.

[2.] Intravenous "Passage" Experiments Similar to those with the Virus H. 17. "Sp.B.", but with other Viruses.

A preliminary experiment was made with the virus H. 8. "S.C."; for the others the lung viruses H. 22. "F.W.", H. 25. "A.T.", and H. 23. "J.P." were selected.

(a) Virus H. 8. "S.C." Intravenous Passage Experiment. (See page 336.)

The intravenous series was commenced with a tissue emulsion of Guinea-pigs 912-915. These were the third of a succession, the first of which had been injected from the original Calf 177. This calf had received a very large dose of a broth culture, which had descended direct from the human mesenteric glands. Thus the virus had passed through a culture, one calf, and three guinea-pigs before it reached the first intravenous calf, No. 305.

Calf 305. Calf 305 received intravenously 9 cc. of tissue emulsion containing 729,000,000 tubercle bacilli. At the same time, Calf 303, which serves as a useful control, received 10 cc. subcutaneously. The latter developed minimal lesions which did not extend beyond the prescapular gland.

The intravenous calf, 305, was killed when very ill, twenty-six days after the injection. The lungs were hepatized anteriorly, and partially so elsewhere. No obvious tubercles were seen, but some minute doubtful grey points were noticed in some of the darker portions. Innumerable little grey dots, apparently tubercles, were seen in the liver. Tubercle bacilli were found in the lungs, liver, spleen, and many lymphatic glands.

An emulsion of the posterior mediastinal gland of Calf 305 was used for the subcutaneous injection of Calves 275 and 325. These developed minimal lesions.

Calf 361. A second calf, 361, was then injected intravenously with 20 cc. of an emulsion of the local lesion of Calf 275, containing 41,000,000 tubercle bacilli. It remained fairly well, and was killed when in good condition seventy-six days after the injection, having gained in weight 43 lbs. One was rather surprised therefore to find innumerable little miliary tubercles in the lungs and liver, while a smaller number appeared in spleen, kidneys, &c. Tubercle bacilli were present everywhere, but were not very numerous. The tubercles in the lungs were grey and translucent peripherally, and more opaque in their centres. In the spleen they were rather larger, yellowish in colour, with thin translucent grey margins.

These two instances of general miliary tuberculosis being caused by the intravenous injection of a virus which was not virulent when injected subcutaneously, were among the first observed, and made a great impression. At the time I was inclined to regard the disease in these animals as progressive, but further experience has shown that in very similar cases this is not the case.

From the second intravenous Calf 361 two calves, 419 and 423, were injected subcutaneously with 20 cc. of an emulsion of the thoracic glands, containing over 6,000,000 bacilli. These calves developed minimal lesions only, and a goat which received half this quantity remained well.

Thus there was no evidence of any increase of virulence.

The residence of the tubercle bacilli in the two intravenous calves, taken together, amounted to 102 days, but between these two they were existing in a retrogressing local lesion of another calf for fifty-nine days. The total duration of residence in the bovine species was 10 months.

(b) Virus H. 22. "F.W." First Intravenous "Passage" Experiment. (See page 337).

Calf 399. The intravenous series was commenced with a tissue emulsion, the lesions of Guinea-pig 1200 being used. This animal had been infected from another guinea-pig which had itself been infected from Calf 291, injected subcutaneously with an emulsion of human lung. Of the guinea-pig tissue emulsion Calf 399 received intravenously a dose containing nearly 720,000,000 tubercle bacilli. The animal was killed when very ill thirty-four days later. There was

tuberculous lobular pneumonia, but no definite tubercles visible to the naked eye. Tubercle bacilli were numerous almost everywhere.

An emulsion of the thoracic gland was made and injected into Calf 457 intravenously, the dose containing 20,000,000 tubercle bacilli. The animal died in fifty-seven days. There was miliary tuberculosis of lungs, and caseation of the bronchial and other thoracic glands. Other parts also were affected. Calf 457.

An emulsion was made of the bronchial glands, and a dose containing over 11,000,000 tubercle bacilli intravenously injected into Calf 505. The animal was killed after sixty-two days. Three minute tubercles only were seen in its lungs, and a considerable number of yellow calcareous grains in the thoracic glands. Calf 505.

There was evidently little chance of success in continuing the series, and it was thought preferable to begin again, using larger doses.

(c) Virus H. 22. "F.W." Second Intravenous "Passage" Experiment. (See page 338).

This time it was necessary to begin with a culture, that from the original Calf 293 being selected. It had at that time been fourteen months in cultivation. A dose of forty-six milligrammes of bacilli from a serum culture, twenty-one days old, was intravenously injected into Calf 749. It was killed when very ill, twenty-four days later. The lungs were extensively consolidated, but without visible tubercles; the thoracic glands were caseous. Calf 749.

An emulsion was made of the thoracic glands, and a dose containing 250,000,000 tubercle bacilli injected into Calf 811. It was killed forty-nine days later. A perivascular lesion at the seat of injection showed that the infective material had failed, at least to a great extent, to reach the circulation. There were no tubercles visible in the lung, and only a few caseous foci in the thoracic glands. Calf 811.

An emulsion was accordingly made from the perivascular lesion, and injected intravenously into Calf 817. The dose contained nearly 891,000,000 tubercle bacilli.

The animal was killed thirty-one days later. There were some small tubercles in the heart and vena cava superior. The lungs were everywhere finely mottled with minute irregular greyish spots and pinkish grey areas. The former lacked the sharpness of outline, roundness and translucency of the usual non-progressive tubercle. In the latter, which were airless, an irregular branch-like more opaque and whitish mottling could be seen on section (probably the ramifications of the terminal bronchi). Calf 817.

An emulsion of lung and another from the bronchial gland, were made for injection, but tubercle bacilli proving very rare in either, they were not used, and the experiment closed.

(d) Virus H. 25. "A.T." First Intravenous "Passage" Experiment. (See page 340.)

The first attempt was made with an emulsion of the prescapular gland of Calf 449. This animal had been injected with an emulsion of the tuberculous organs of a guinea-pig infected with the human lung, a dose of 10 cc., containing 11,000,000 tubercle bacilli, being intravenously injected into Calf 467.

The calf was killed after sixty-two days. Only ten or a dozen very small tubercles, as clear as glass, and each with a minute opaque centre, were found in the lungs. The bronchial and other thoracic glands contained a few calcareous grains. Four small tubercles with yellow centres were found in the liver, and one in the spleen. The hepatic gland contained a few calcareous grains. Calf 467.

The disease was clearly not progressive, and it was thought better to begin again with a larger dose rather than to go on.

(e) Virus H. 25. "A.T." Second Intravenous "Passage" Experiment. (See page 339).

In this experiment a culture derived from Calf 417, the animal injected with the original lung tissue, was used. At that time it had been nearly eleven months in artificial cultivation.

100 mg. of bacilli were injected intravenously into a

Bull 551.

young bull, No. 551, about ten months old, and weighing 3 cwt. 3 qrs. 18 lbs., about three times as much as the calves generally used.

The bull died twenty-one days later. The lungs were heavy and extremely congested; innumerable minute tubercles were distinctly visible in some of the darker lobules, and elsewhere one could make them out with more or less certainty. The liver was faintly mottled, as though with innumerable barely visible tubercles. The thoracic glands were greatly enlarged, and their cortex opaque and white.

An emulsion was made from the posterior thoracic gland, and 12 cc., containing nearly 1,000 million tubercle bacilli, were intravenously injected into Calf 831.

Calf 831.

This animal died seventeen days later with extreme congestion of a considerable part of the small intestine, which was thought to be due to infarction. The lungs were congested and mottled, but no tubercles could be seen in them. The thoracic glands, slightly swollen, were a little firmer than normal. Tubercle bacilli were found in all the great organs and in all the glands examined.

An emulsion was made of the right bronchial gland, and 23 cc., containing 2,000 million tubercle bacilli were intravenously injected into Calf 859. The animal died nineteen days later. Little tubercles were numerous in the right side of the heart. The lungs were purple and intensely congested, and they were almost entirely consolidated. They showed an indistinct grey mottling, but no definite tubercles could be seen. The bronchial and other thoracic glands were much enlarged and firmer than normal.

Calf 859.

An emulsion was made of the thoracic glands, and 11½ cc., containing 346 million tubercle bacilli, were intravenously injected into Calf 861.

Calf 861.

This animal was killed when very ill thirty days after injection. Minute tubercles were found on the endocardium of the right side of the heart. The lungs were voluminous and heavy; portions of the anterior lobes, and scattered deeply-seated lobules elsewhere, were consolidated. Other parts were mottled with innumerable little reddish points, but no tubercles were distinctly visible. The thoracic glands were enlarged. Tubercle bacilli in the lungs and in the thoracic glands were very scanty, so few indeed that it seemed useless to inject another calf.

Two rabbits, Nos. 539 and 540, were injected intraperitoneally with the emulsion used for the last calf. When killed more than a year later, one was found to be fat and well and had only a few translucent tubercles in the meso-colon and omentum; the other was thin, and in addition to the usual minimal lesions had destructive caseous tuberculosis of one knee and of the opposite ankle joint. Other instances of tuberculosis of joints have occurred in rabbits injected with viruses of Group II., and the caseous matter from one of these joints has been injected into another

rabbit without producing anything more than the usual minimal lesions characteristic of injections with bacilli of Group II. (See Rabbits 263 and 639 in the H. 12. "H.N." Rabbit "Passage" experiment which follows.) Rabbit 539 then does not afford any evidence of increase of virulence. In brief, four calves were intravenously injected in succession with doses so large as to cause fatal results, and yet no increase of virulence was obtained.

This experiment seems to be a very clear and complete negative one, and it is difficult to see what more could be done, short of extending it further, to favour the growth of the bacilli in the body of the bovine animal. The total duration of the experiment from the first intravenous injection to the death of the last calf was only eighty-seven days, and yet four calves were used. It seems one must either use a very large dose capable of killing in three weeks or less, or one will not produce any serious infection, and thus will be unable to recover sufficient tubercle bacilli to continue the series.

(f) *Virus H. 23. "J.P." First Intravenous "Passage" Experiment.* (See page 340.)

Calf 441 received an intravenous injection of an emulsion of the prescapular gland of Calf 345, one of the calves injected with the original lung emulsion. The amount injected was 20 cc., and it was estimated to contain over 13,000,000 tubercle bacilli. The animal was killed 102 days later. Some of the lobules in the lungs were consolidated and calcified, and there were a number of little grey pin point tubercles. Little calcareous points were found in the thoracic glands, and numerous little tubercles were just visible in the liver. There were also little tubercles elsewhere. A perivascular tumour at the seat of inoculation showed that the injection had not been entirely intravenous. Tubercle bacilli were sought in all affected parts and elsewhere, but were found only in the lung and the popliteal gland, and then in very small numbers. It was therefore decided to abandon the attempt with this virus.

Calf 441.

[3.] Rabbit "Passage" Experiments.

Attempts to increase the virulence of tubercle bacilli by continued growth in rabbits have been made with twelve viruses.

The largest possible doses were injected throughout. The first injections were usually made into two animals, into one intravenously and the other intraperitoneally. Subsequent injections were made intraperitoneally with emulsions of tuberculous tissue. No series of intravenous injections have been made, because they are so rapidly fatal.

The following is a list of the viruses used, the number of "passages," and the total duration of each experiment:—

Virus.	Probable primary seat of disease.	Number of passages through Rabbits.	Total duration of experiment.
H. 12. "H.N." ...	Mesenteric glands	{ (a) 5 (b) 4 (c) 2	21 months. 24 months. 10 months.
H. 8. "S.C." ...	" "	2	6 months.
H. 18. "T.T." ...	" "	2	13 months.
H. 30. "E.M." ...	" "	2	8½ months.
H. 33. "R.T." ...	Cervical glands	{ (a) 3 (b) 3	21 months. 21 months.
H. 22. "F.W." ...	Lung	{ (a) 3 (b) 2	12½ months. 6 months.
H. 45. "F.M." ...	" "	{ (a) 3 (b) 3 (c) 2	13½ months. 13½ months. 10 months.
H. 25. "A.T." ...	" "	2	12½ months.
H. 11. "E.D." ...	Elbow joint	3	12 months.
H. 9. "C.T." ...	Wrist joint	2	5 months.
H. 47. "S.B." ...	Hip joint	2	14 months.
H. 16. "J.H." ...	Knee joint	{ (a) 1 (b) 1	7 months. 5½ months.

The details of these experiments will be found in the tables. It will suffice to say here that no increase of virulence was observed, although in one experiment a virus H. 12 "H.N." was passed through five rabbits in succession, the whole of this "passage" occupying a period of twenty-one months. This virus had on two occasions produced in calves a number of widely distributed non-progressive tubercles, considerably in excess of those commonly caused by a virus of Group II. One of the rabbits, No. 271, the third of the series, was found when killed in addition to the ordinary lesions to have caseous tuberculosis of the right knee-joint. Another rabbit, No. 640, injected with an emulsion of a caseous mass in the peritoneal cavity of this animal, died after 145 days from chronic progressive tuberculosis. (For post-mortem *see* below.) But another rabbit, 813, injected with an emulsion of the lung of this one, developed the usual minimal lesions, and thus proved that no real increase of virulence had taken place. The experiment was carried out in duplicate, the second series running through four rabbits, and occupying a period of two years. In the third rabbit, No. 263, there was found, when killed, to be caseous tuberculosis of the right knee-joint. The caseous matter from this joint, however, injected into Rabbit 639, produced only the usual minimal lesions.

Another rabbit, No. 260, developed chronic progressive tuberculosis. This was the third of a series injected with the virus H. 22. "F.W." obtained from a case of human phthisis. The total duration of the experiment was just over a year. Unfortunately this animal died at a time when it was not possible to pass the virus on, but it seems reasonable to believe that had this been done the experience obtained with Rabbit 640 would have been repeated. This animal therefore is not regarded as affording any evidence of increase of virulence.

One other rabbit may be referred to here, namely No. 414, injected with culture derived from the virus H. 47. "S.B.," originally obtained from a human tuberculous hip-joint. Killed after 89 days, this animal had rather severe chronic tuberculosis of the lungs, and its uterus, as is not uncommonly the case, was distended with tuberculous pus. This pus, in-

jected into another rabbit, 553, produced only minimal lesions. The post-mortem examinations of those rabbits which were more affected than usual are given below in full, but it is not thought necessary to give any more details than those which appear in the table concerning the rabbits which developed only the usual minimal lesions.

In the table of these rabbit "passage" experiments is included a single passage experiment through the rat. The rat, No. 28, had been injected with the virus H. 16. "J.H." obtained from a human knee-joint. It died of tuberculosis 172 days after injection. Rabbits were injected both with culture and with tissue emulsions derived from the lesions of this rat. The results in all cases were the usual minimal lesions characteristic of a virus of Group II.

Summary.

The experiments here reported represent a somewhat extended attempt to increase the virulence of feebly virulent tubercle bacilli by "passage" through refractory animals. Many other attempts have been made earlier by passage through the susceptible guinea-pig, and passage through the rat has not been neglected. It will be remembered also that with many of our earlier feebly virulent viruses passage from calf to calf, or from calf to guinea-pig, and thence again to calf, were freely used, with negative results.

All this amounts to a strong body of evidence, which demonstrates the stability of virulence of the tubercle bacillus in the living animal; and on the other hand, high virulence has been found to be scarcely perceptibly diminished by long-continued growth on artificial media.

The virulence of tubercle bacilli being in general so remarkably stable, one must look for some special or exceptional circumstance to explain the limited number of instances in which virulence has changed.

Whatever be the explanation of these positive passage experiments, the fact remains that they are exceptional, and that in general the virulence of tubercle bacilli, be it high or low, is not readily altered.

POST-MORTEM EXAMINATIONS OF THE MORE SEVERELY AFFECTED RABBITS.

POST-MORTEM ON RABBIT 260. VIRUS H. 22. "F.W."

Died 205 days after an intraperitoneal injection.

In the *Peritoneal Cavity* were three large lobulated tumours, on section resembling brain, and having the consistence of soft putty.

Omentum was normal. There were no tubercles in the peritoneal cavity.

Liver and Spleen were normal.

Kidneys contained large prominent caseo-fibrous tubercles.

Lungs contained, besides caseous tubercles, numerous large cavities, some half an inch in diameter, with smooth caseous walls and containing little else besides air.

Microscopical Examination.

Lung.—Numerous tubercle bacilli, no other micro-organisms seen.

POST-MORTEM ON RABBIT 263. VIRUS H. 12. "H.N."

Killed 240 days after an intraperitoneal injection.

The *Peritoneal Cavity* contained only a few small circular fibro-caseous tubercles in the gastro-splenic omentum, the falciform ligament, and on the surface of liver.

The *Liver substance, Spleen and Kidneys* were normal.

The *Right Lung* contained large irregular fibro-caseous nodules; the *Left Lung* was normal.

The *Right Knee Joint* was tuberculous. It contained excess of fluid with caseous flakes. Considerable collections of soft caseous matter were packed away in corners, and the synovial membrane was swollen, gelatinous and caseous.

Microscopical Examination.

Emulsion of caseous material from knee.—Tubercle bacilli numerous.

POST-MORTEM ON RABBIT 271. VIRUS H. 12. "H.N."

Killed 233 days after an intraperitoneal injection. The rabbit was well grown and fat. In the *abdominal cavity* were eight or ten large spherical collections of soft caseous matter resembling soft putty, enclosed in a thin membrane and attached to the cæcum, spleen, or some other part. They were as large as cherries, and some even larger; besides these were many smaller ones.

The *Lungs, Kidneys and other organs* were normal.

The *Right Knee-joint* contained caseous deposit in the mucous membrane.

The *Right Popliteal Gland* was enlarged and soft, but not caseous.

Microscopical Examination.

Emulsion of caseous matter from abdominal cavity.—No tubercle bacilli seen.

Scraping from Right Popliteal Gland.—No tubercle bacilli seen.

TABLE OF "PASSAGE" EXPERIMENTS ON RABBITS.

Viruses used for the Rabbit Experiments. [The probable primary seat of disease in man is indicated in brackets.]	Primary Inoculation.								First "Passage"—All Intraperitoneal.							Second "Passage"—All Intraperitoneal.							Third "Passage"—All Intraperitoneal.							
	Strain of Tubercle Bacilli with which the Experiment commenced.	Number of Rabbit.	Dose.	Date.	Duration of Life in Days.		Killed or Died.	Result.	Description and Source of Tissue Emulsion used for Injection.	Number of Rabbit.	Dose.	Date.	Duration of Life in Days.	Killed or Died.	Result.	Description and Source of Tissue Emulsion used for Injection.	Number of Rabbit.	Dose.	Date.	Duration of Life in Days.	Killed or Died.	Result.	Description and Source of Tissue Emulsion used for Injection.	Number of Rabbit.	Dose.	Date.	Duration of Life in Days.	Killed or Died.	Result.	
					Intrap.	Intrav.																								
H. 12. "H.N." [Mesenteric glands.]	Culture from Calf 319, direct.	137	About three tube cultures.	Aug. 30, 1904.	—	14	D.	Consolidation of lungs; no tubercles visible.	Emulsion of lung of Rabbit 137.	[138 139	20 cc. very rich in T.B. "	Sept. 13, 1904. "	170 163	K. D.	Abdominal cysts; few tubercles in kidney, one in lung. Slight tuberculosis of lungs and peritoneum.	Encysted material from abdomen of Rabbit 138.	271	14 cc. [T.B. not very numerous.]	Mar. 2, 1905.	233	K.	Large caseous spherical masses in abdominal cavity. All organs normal. Caseous tuberculosis of right knee joint.	Caseous mass from peritoneal cavity of Rabbit 271.	640	30 cc. [No T.B. seen in emulsion.]	Oct. 21, 1905.	145	D.	Chronic progressive tuberculosis.	
	Do. do.	136	Two tube cultures.	Aug. 30, 1904.	121	—	K.	Mass of putty-like material encysted in meso-colon. Few small T's in omentum. Tuberculous pyelitis of both kidneys.	Emulsion of caseo-purulent matter from pelvis of Rabbit 136.	229	8 cc. [T.B. not very numerous.]	Dec. 29, 1904.	187	K.	Trace of tuberculosis in peritoneum and lungs.	Caseous patches from lung of Rabbit 139.	263	15 cc. [T.B. in moderate numbers.]	Feb. 23, 1905.	240	K.	Few fibrous tubercles in peritoneum. Caseo-fibrous nodules in right lung. Caseous tuberculosis of right knee joint.	Caseous matter from knee-joint of Rabbit 263.	639	23 cc. fairly rich in T.B.	Oct. 21, 1905.	297	K.	Chronic tuberculous peritonitis. Trace in lungs and kidneys.	
H. 8. "S.C." [Mesenteric glands.]	Emulsion of lesions of G.-P.'s 1230-1231, from Calf 275.	101	5 cc. [Tubercle bacilli numerous.]	June 28, 1904.	59	—	K.	Slight tuberculous peritonitis. Some minute grey tubercles in lungs.	E. of lesions from Rabbit 101.	129	12 cc. [T.B. not numerous.]	Aug. 26, 1904.	118	K.	Small caseous local lesion. Few foci in omentum. One fibrous focus in lung.															(From Rabbit 640.)
H. 18. "T.T." [Mesenteric glands.]	Culture from G.-P. 1174 (descended from Calf 131).	154	8 cc. of top fluid of emulsion of culture.	Sept. 26, 1904.	—	157	K.	Tuberculous pyelitis of both kidneys. A few caseous tubercles in the lungs.	Emulsion of pus from kidneys, with a trace of caseous matter from lung of Rabbit 154.	272	11 cc. [T.B. fairly numerous.]	Mar. 2, 1905.	237	K.	Trace of tuberculosis in peritoneum.															Fourth "Passage"—Intraperitoneal.
H. 30 "E.M." [Mesenteric glands.]	Culture from human mesenteric and bronchial glands, through G.-P. 1137.	216	10 mg. of culture.	Dec. 20, 1904.	88	—	K.	Slight tuberculous peritonitis. Tuberculosis of lungs and kidneys.	E. of lung from Rabbit 216.	300	16 cc. [T.B. in moderate numbers.]	Mar. 18, 1905.	165	D.	Chronic tuberculous peritonitis. Slight tuberculosis of kidneys.															
H. 33. "R.T." [Cervical glands.]	Culture from human axillary glands direct.	192	About 50 mg. of culture.	Nov. 14, 1904.	107	—	K.	Widespread tuberculosis of chronic type.	Pus from pelvis of kidney of Rabbit 192. Pus from meso-colon of Rabbit 192.	268 269	13 cc. [T.B. fairly numerous.] 10 cc. [T.B. numerous.]	Mar. 1, 1905. Mar. 1, 1905.	138 238	K. when ill. K.	Slight chronic tuberculosis of peritoneum, lungs and right kidney. Trace of tuberculosis in peritoneum.	Emulsion of lung from Rabbit 268. Emulsion of caseous matter from peritoneal cavity of Rabbit 269.	{523 524 641	10 cc. [T.B. rather scanty.] 5 cc. [T.B. rather scanty.] 10 cc. [T.B. fairly numerous.]	July 17, 1905. July 17, 1905. Oct. 25, 1905.	393 393 289	K. K. D.	Caseous nodules in wall of caecum. Injection possibly into the wall of the caecum. Trace of tuberculosis in lungs. Slight tuberculosis of peritoneum, lungs, and kidneys.								
H. 22. "F.W." [Lung] ...	Culture from Calf 293, direct.	134	About four tube cultures.	Aug. 29, 1904.	16	—	D.	Tuberculous peritonitis. One tubercle in right kidney.	E. of omentum from Rabbit 134.	[141 140	10 cc. rich in T.B. "	Sept. 14, 1904. Sept. 14, 1904.	160 160	K. K.	Slight tuberculosis of chronic type. Slight tuberculosis of chronic type.	Emulsion of peritoneal abscess from Rabbit 141.	260	3 cc. [T.B. in considerable numbers.]	Feb. 21, 1905.	205	D.	Chronic progressive tuberculosis with cavities in lungs. Three large lobulated caseous tumours in abdominal cavity in which no T.B. could be found. No tubercles on peritoneum. Large prominent caseo-fibrous tubercles in lungs.								
H. 45. "F.M." [Lung] ...	Culture derived from human bronchial glands through G.P. 1137.	[133 131	About 2 tube cultures. "	Aug. 29, 1904. "	— 115	25 —	D. K.	Consolidation of lungs, minute tubercles in same, and many small tubercles in kidneys. Slight tuberculous peritonitis. Pyelitis of both kidneys.	Emulsion of kidney from Rabbit 133. Caseous matter from pelvis of kidney of Rabbit 131.	[145 146 222	15 cc. [T.B. in moderate numbers.] do. 3 cc. fairly rich in T.B.	Sept. 23, 1904. Sept. 23, 1904. Oct. 22, 1904.	227 153 194	K. K. K.	Very slight tuberculosis at seat of inoculation, in peritoneum, kidneys, and lungs. Slight tuberculous peritonitis. Slight tuberculosis of lungs and kidneys. Trace of tuberculosis in peritoneum and kidneys.	Emulsion of caseous matter from kidneys of Rabbit 145. Pus from pelvis of kidney from Rabbit 146.	394 264	12 cc. rather rich in T.B. 10 cc. rich in T.B.	May 8, 1905. Feb. 23, 1905.	157 240	D. K.	Slight tuberculosis of kidney. Trace in peritoneum. Perfectly healthy and very fat.								

TABLE OF "PASSAGE" EXPERIMENTS ON RABBITS--continued.

Viruses used for the Rabbit Experiments. [The probable primary seat of disease in man is indicated in brackets.]	Primary Inoculation.								First "Passage"—All Intraperitoneal.								Second "Passage"—All Intraperitoneal.							
	Strain of Tubercle Bacilli with which the Experiment commenced.	Number of Rabbit.	Dose.	Date.	Duration of Life in Days.		Killed or Died.	Result.	Description and Source of Tissue Emulsion used for Injection.	Number of Rabbit.	Dose.	Date.	Duration of Life in Days.	Killed or Died.	Result.	Description and Source of Tissue Emulsion used for Injection.	Number of Rabbit.	Dose.	Date.	Duration of Life in Days.	Killed or Died.	Result.		
					Intrap.	Intrav.																		
H. 25. "A.T." [Lung] ...	Emulsion of bronchial gland of Calf 831.	538	Small dose	July 24, 1905.	283	—	D.	Chronic tuberculous disease of kidneys.	E. of caseous material from pelvis of kidneys of Rabbit 538.	874	10 cc. [T.B. scanty.]	May 3, 1906.	103	K.	Slight tuberculosis of peritoneum and one kidney.									
H. 11. "E.D." [Elbow joint]	Culture derived from Calf 309, direct.	149	About 5 tube cultures.	Sept. 26, 1904.	23	—	D.	Tuberculous peritonitis. Few tubercles in lungs and kidneys.	E. of peritoneal tubercles from Rabbit 149.	176 177	20 cc. [T.B. numerous.] 10 cc. [T.B. numerous.]	Oct. 19, 1904. Oct. 19, 1904.	133 201	K. D.	Some encysted collections of pus in abdomen. Slight tuberculosis of both kidneys. Very slight tuberculosis of peritoneum, lungs, and kidneys.	Emulsion of all tuberculous tissues from Rabbit 176.	270	13 cc. [T.B. fairly numerous.]	Mar. 1, 1905.	234	K.	Trace of tuberculosis in peritoneum.		
H. 9. "C.T." [Wrist joint]	Culture derived from Calf 201, through G.P. 1181.	151	About 4 tube cultures.	Sept. 26, 1904.	21	—	D.	Tuberculous peritonitis. Few translucent tubercles in lungs.	E. of omentum from Rabbit 151.	174 175	8.5 cc. very rich in T.B. 6.0 cc. very rich in T.B.	Oct. 17, 1904. Oct. 17, 1904.	135 135	K. K.	Minimal tuberculosis of peritoneum and lungs. A few translucent tubercles in lungs.									
H. 47. "S.B." [Hip joint]...	Culture derived from human tissues through G.P. 1430.	414	1.0 mg. of culture.	May 22, 1905.	89	—	K.	Slight tuberculous peritonitis. Chronic tuberculosis of lungs, rather severe. Trace in kidneys.	E. of pus from uterus of Rabbit 414.	553	4 cc. very rich in T.B.	Aug. 19, 1905.	360	K.	Slight tuberculosis of peritoneum and kidneys.									
H. 16. "J.H." [Knee joint] ["Passage" through a rat.]	Emulsion of lesions from Rat 28, injected with a strain derived from human synovial membrane, through G.P. 609. Culture from Rat 28 direct.	334 335 429 431	7 cc. very rich in T.B. " 0.1 mg. of culture. 10.0 mg. of culture.	April 4, 1905. " May 28, 1905. "	220 220 169 169	— — — —	K. K. K. K.	Slight tuberculosis of peritoneum and kidneys. Slight tuberculosis of peritoneum and lungs. Trace in one kidney. Slight tuberculosis of omentum and kidneys. Trace of tuberculosis in peritoneum and right kidney.																

POST-MORTEM ON RABBIT 640. VIRUS
H. 12. "H.N."

Died 145 days after an intraperitoneal injection.

There was a caseous lesion in the *abdominal wall* at the seat of inoculation, and one of the *axillary glands* was caseous. There were some yellow streaks on the posterior wall of the *omentum*.

Almost the whole of the anterior surface of the *liver* was covered with large tuberculous plaques, loosely attached at their margins, and adherent to the diaphragm. These were nearly $\frac{1}{4}$ inch thick, composed of tough greyish tissue, with a great many caseous patches. Between the liver and the right side of the diaphragm, and separated from the latter by one of these plaques, was a large encysted mass the size of a hen's egg of softened caseous tissue, such as one frequently sees after the injection of very large doses of non-virulent tubercle bacilli.

There were many caseo-fibrous tubercles elsewhere on the *peritoneum*, namely on the surface of the *stomach* and *cæcum*, and especially around the *spleen*, which was not enlarged, and had no tubercles in its interior.

The *Kidneys* were pale, but except for one or two minute points under the capsule, were free from tubercle.

The *Lungs* were thickly packed with a moss-like caseous network: this had a very inconspicuous grey margin. The air-containing lung tissue was scanty and bright red. The disease of the lung appeared sufficient to account for death.

Microscopical Examination.

Emulsion of lung.—Tubercle bacilli fairly numerous.

POST-MORTEM ON RABBIT 192. VIRUS
H. 33. "R.T."

Killed 107 days after an intraperitoneal injection.

There were a few translucent tubercles with caseous centres scattered throughout the *peritoneum*, on the *vesical*, *falciform*, and *broad ligaments*, &c. In addition there were also numerous soft lobulated yellow masses, up to the size of a large shot or small pea, in both *omentums* or in the *meso-colon*. In the latter situation the largest of these masses was $\frac{1}{2}$ inch in diameter. They were composed of thick caseo-pus in a thin wall of peritoneum. In the *mesentery* irregular patches were situated in the middle of the polygonal areas into which it was divided by the blood vessels.

On the surface of the *liver* there were some fibro-caseous tubercles $\frac{1}{8}$ or $\frac{1}{4}$ inch in diameter, raised and flattened, with over-hanging margins.

The *Spleen* was normal.

The *Kidneys* contained a few tuberculous striae, and there was some caseo-pus in the pelvis of each.

The *Lungs* contained widely scattered small irregular fibrous patches with yellow points.

There were two tubercles in the right side of the heart.

Microscopical Examination.

Emulsion of pus from pelvis of kidney.—Tubercle bacilli fairly numerous and of moderate length.

Emulsion of caseous mass from meso-colon.—Tubercle bacilli numerous, commonly in rounded masses, extremely short. No other micro-organisms.

POST-MORTEM ON RABBIT 538. VIRUS
H. 25. "A.T."

Died 283 days after an intraperitoneal injection.

A very strong, fat rabbit.

There were some caseous softened collections in the posterior layer of the *omentum*.

The *Kidneys* were enlarged, the pelves and calyces distended, especially in the right, with an enormous quantity of softened caseous matter. The kidney substance was very tough and congested, and the surface of each organ was marked by irregular depressed areas of a bluish purple colour.

Liver and Spleen.—Normal.

There was a large hæmorrhage occupying the whole of one of the smaller lobes of the right lung. No tubercles were seen in the organ.

Microscopical Examination.

Emulsion of caseous material from kidney.—A few tubercle bacilli.

POST-MORTEM ON RABBIT 414. VIRUS
H. 47. "S.B."

Killed 89 days after an intraperitoneal injection.

There were a moderate number of opaque tubercles in the *omentum*, but scarcely any were seen elsewhere in the *peritoneum*.

Liver and Spleen.—Normal.

One or two little tubercles were seen in each kidney.

The *Lungs*.—Were rather thickly packed with more or less confluent grey tubercles with opaque centres.

The *Uterus*.—Was distended with creamy pus.

Microscopical Examination.

Pus from uterus.—Swarming with tubercle bacilli.

POST-MORTEM ON RABBIT 539. VIRUS
H. 25. "A.T."

Killed 373 days after an intraperitoneal injection.

Some small fibro-calcareous tubercles were seen in the *omentum*.

Liver and Spleen.—Normal.

Some caseous striae were seen in the medulla of the right kidney, and a small tubercle in the apex of the pyramid of the left. There were a few fibro-caseous nodules in the lung.

The right knee joint and the left ankle joint were tuberculous.

VIRUS H. 16. "J.H."

Second "Passage" Experiment.

(For Chart of the first "Passage" Experiment see Appendix to 2nd Interim Report, Vol. II.)

CULTURE.

Derived from human synovial membrane, through G.-P. 609.

October 14, 1904.

[After 14 months' artificial cultivation.]

BULL-CALF 527.

Subcutaneous.

Dose : 50 mg.

Killed, January 12, 1905.

(90 days.)

P.M.—Small local abscess ; few caseo-calcareous foci in prescapular gland ; about 30 in mesenteric glands ; few small tubercles in small intestine.

E. of mesenteric tubercles.

E. of prescapular gland and local lesion.

RABBIT 237 [Intrap.].

Killed, 116 days.

P.M.—Trace of tuberculosis in peritoneum.

BULL-CALF 631.

Subcutaneous.

Dose : 5,014,800,000 T.B.

Killed, May 5, 1905.

(113 days.)

P.M.—Small local ulcer ; caseo-calcareous patches in prescapular gland.

E. of prescapular gland.

RABBIT 389 [Intrap.].

Killed, 192 days.

P.M.—Trace of tuberculosis in omentum.

BULL-CALF 753.

Subcutaneous.

Dose : 14,490,000 T.B.

Killed, August 9, 1905.

(96 days.)

P.M.—Few calcareous grains at seat of inoculation ; one yellow focus in prescapular gland.

EXPERIMENT CLOSED.

VIRUS H. 17. "Sp.B."

Second "Passage" Experiment.

(For Chart of the first "Passage" Experiment see Appendix to 2nd Interim Report, Vol. II.)

CULTURE.

Derived from Calf 339, through G.P. 1235.

February 28, 1905.

[after 8 months' artificial cultivation.]

COW-CALF 685.

Intravenous.

Dose : 10.0 mg.

Killed : May 3, 1905. (64 days.)

P.M.—Pea-sized lesion in wall of vein; moderate number of tubercles (up to one-eighth inch) in lungs. No T.B. found in emulsion of thoracic glands and very few in emulsion of lung tubercles.

RABBIT

injected intraperitoneally with E. of lung tubercles.

Number.	Duration of Life.	Result.
380	K. 191 days	Normal throughout.

RABBITS [Intrap.].

Number.	Dose.	Duration of Life.	Result.
265	50.0 mg.	D. 73 days	Trace of tuberculosis in left kidney; death from pneumonia.
266	10.0 mg.	K. 91 "	Very slight tuberculous peritonitis; few tubercles in lung and kidney.
267	1.0 mg.	K. 91 "	Slight tuberculosis of peritoneum and lungs.

Experiment failed.
Insufficient material to pass on.

Third "Passage" Experiment.

CULTURE.

As above.

May 26, 1905

[after 11 months' artificial cultivation.]

BULL 607.

Intravenous.

Dose : 90.0 mg.

Killed : July 13, 1905.
(48 days.)

P.M.—Small caseous tumour outside wall of vein at seat of inoculation. A good many small tubercles in kidneys. The lungs appeared somewhat indurated, but contained no tubercles; no T.B. were found in them, nor in the thoracic glands, liver, or spleen, and only two T.B. were seen in a preparation from the kidney tubercles.

RABBITS [Intrap.].

Number.	Dose.	Duration of Life.	Result.
424	10.0 mg.	D. 5 days	Psorospermosis.
425	10.0 mg.	D. 17 "	Early tuberculous peritonitis; death from other causes.
426	27.5 mg.	K. 171 "	Slight tuberculosis of peritoneum and kidneys.

This experiment also was stopped for same reason.

VIRUS H. 8. "S.C."

First "Passage" Experiment.

CULTURE.

Derived from human mesenteric glands, direct.

July 10, 1903.

CALF 177.

Subcutaneous.

Dose : 3,000 milligrammes of bacilli from broth culture. Killed : September 2, 1903. (54 days.)

P.M.—Softened local lesion ; prescapular gland slightly affected.

G.P.'s 763-766.

G.P.'s 849-852.

G.P.'s 912-915.

December 21, 1903.

CALF 305.

Intravenous.

Dose : 728,879,000 T.B.

Killed when very ill : January 16, 1904.
(26 days.)

P.M.—Early general tuberculosis.

CALF 303.

Subcutaneous.

Dose : 809,869,000 T.B.

Killed : April 13, 1904.
(114 days.)

P.M.—Minimal local lesion ; calcareous nodules in prescapular gland.

E. of thoracic gland.

CALF 275.

Subcutaneous.

Dose : 12,550,000 T.B.

Killed : March 15, 1904.
(59 days.)

P.M.—Small local lesion ; caseous nodules in nearest glands. Few yellow foci in thoracic glands.

E. of local lesion.

CALF 361.

Intravenous.

Dose : 41,550,000 T.B.

Killed : May 30, 1904.
(76 days.)

P.M.—General miliary tuberculosis.

E. of thoracic glands.

CALF 419.

Subcutaneous.

Dose : 6,146,000 T.B.

Killed : September 1, 1904.
(94 days.)

P.M.—Minimal local lesion ; yellow in prescapular gland.

CALF 423.

Subcutaneous.

Dose : 6,146,000 T.B.

Killed : September 1, 1904.
(94 days.)

P.M.—Small local lesion ; caseo - calcareous nodules in nearest glands. Two minute foci in posterior thoracic gland.

RABBIT. [Intrap.]

Number.	Duration of Life.	Result.
36	K. 132 days	Small lesion at seat of inoculation. One small tubercle in each lung.

EXPERIMENT CLOSED.

VIRUS H. 22. "F.W."

First Intravenous "Passage" Experiment

Strain derived from Calf 291, through G.P. 1200.

May 4, 1904.

E. of lesions from G.P. 1200.

CALF 399.

Intravenous.

Dose : 719,733,000 T.B.

Killed : June 7, 1904, when very ill.
(34 days.)

P.M.—Tuberculous lobular pneumonia : no visible tubercles, but T.B. numerous almost everywhere.

RABBITS.

Number.	Method.	Duration of Life.	Result.
81	Intrap.	K. 114 days	Slight tuberculous peritonitis. One or two translucent tubercles in lungs. Tuberculous pyelitis of both kidneys.
82	Intrav.	D. 84 "	

E. of thoracic glands.

CALF 457.

Intravenous.

Dose : 20,000,000 T.B.

Died : August 3, 1905. (57 days.)

P.M.—Miliary tuberculosis of lungs. Caseation of thoracic glands. Intestines and mesenteric glands affected.

RABBITS.

Number.	Method.	Duration of Life.	Result.
98	Intrap.	D. 51 days	One or two tubercles in lungs and kidneys. Death due to septic peritonitis. Slight tuberculous peritonitis. Grey tubercles in lungs and kidneys.
99	Intrav.	K. 65 "	

E. of bronchial gland.

CALF 505.

Intravenous.

Dose : 11,150,000 T.B.

Killed : October 4, 1904. (62 days.)

P.M.—Three minute tubercles in lungs. A considerable number of yellow calcareous grains in thoracic glands.

RABBITS.

Number.	Method.	Duration of Life.	Result.
117	Intrap.	K. 91 days	Almost normal.
118	Intrav.	K. 91 "	Very slight tuberculous peritonitis of lungs and kidneys.

Experiment closed. Insufficient material to pass on.

VIRUS H. 22. "F.W."—*continued.*

Second "Passage" Experiment.

CULTURE.

Derived from Calf 293 direct.

May 3, 1905.

[After 14 months artificial cultivation.]

BULL-CALF 749.

Intravenous.

Dose : 46 mg.

Killed, when very ill, May 27, 1905.
(24 days.)

P.M.—Lungs extensively consolidated—no visible tubercles. Caseation of thoracic glands.

RABBITS [Intrap.].

Number.	Dose.	Duration of Life.	Result.
381	50.0 mg.	K. 68 days	Slight tuberculosis of peritoneum, lungs and kidneys.
382	10.0 mg.	K. 90 "	Slight tuberculosis of peritoneum and kidneys. Trace in lungs. Uterus distended with tuberculous pus.
383	1.0 mg.	K. 90 "	Slight tuberculosis of peritoneum and kidneys.
384	0.1 mg.	K. 90 "	Slight tuberculosis of peritoneum and lungs. Trace in kidney.

E. of thoracic glands.

BULL-CALF 811.

Intravenous.

Dose : 250,000,000 T.B.

Killed : July 15, 1905. (49 days.)

P.M.—Perivascular tumour at seat of inoculation. No tubercles in lungs. Some caseous foci in thoracic glands.

RABBITS [Intrap. Dose : 10,000,000 T.B.]

Number.	Duration of Life.	Result.
427	K. 88 days	Slight tuberculosis of lung. Trace in peritoneum and right kidney.
428	K. 88 "	Very slight tuberculosis of lung. Trace in peritoneum and kidneys.

BULL-CALF 817.

Intravenous.

Dose : 890,880,000 T.B.

Killed : August 15, 1905. (31 days.)

P.M.—Some tubercles in heart and vena cava superior. Lungs extensively mottled with irregular foci. Few T.B. in these and none in other organs.

RABBIT [Intrap.].

Number.	Duration of Life.	Result.
522	K. 39 days (Spine broken)	Commencing tuberculous peritonitis.

GUINEA-PIG [Intrap.].

Number.	Duration of Life.	Result.
508	D. 34 days	G. T.

Experiment closed.

VIRUS H. 25. "A.T."
Second "Passage" Experiment.

CULTURE.

Derived from Calf 417, direct.

JUNE 16, 1905.

[After 10½ months artificial cultivation.]

BULL 551.

Intravenous.

Dose : 100 mg.

Died : July 7, 1905.

(21 days.)

P.M.—Lungs consolidated. Thoracic glands enlarged ; in an early stage of caseation. Few T.B. in films from liver and spleen.

RABBITS [P.].

Number.	Dose.	Duration of Life.	Result.
479	50.0 mg.	Killed 116 days.	Trace of tuberculosis in peritoneum, lungs and left kidney.
476	10.0 mg.		Trace of tuberculosis in peritoneum and one kidney.
477	1.0 mg.		Slight tuberculosis of lungs.
478	0.1 mg.		Trace of tuberculosis in peritoneum and one kidney.

E. of post-thoracic gland.

BULL-CALF 831.

Intravenous.

Dose : 999,600,000 T.B.

Died : July 24, 1905.

(17 days.)

P.M.—Numerous minute tubercles in heart. T.B. in all organs, and in all glands examined. Death from intestinal trouble.

RABBIT [P.].

Number.	Duration of Life.	Result.
517	Killed, 320 days	Trace of tuberculosis in peritoneum.

E. of right bronchial gland.

BULL-CALF 859.

Intravenous.

Dose : 2,044,700,000 T.B.

Died : August 12, 1905.

(19 days.)

P.M.—Numerous minute tubercles in right side of heart. Lungs almost entirely consolidated ; no definite tubercles. No visible change in abdominal organs.

RABBITS [P.].

Number.	Duration of Life.	Result.
537	Died, 3 days	Psorospermiosis.
538	Died, 283 "	Death from chronic tuberculous disease of kidneys.

E. of thoracic gland.

BULL-CALF 861.

Intravenous.

Dose : 345,906,000 T.B.

Killed (very ill) : September 11, 1905.

(30 days.)

P.M.—Lungs heavy and partly consolidated ; no definite tubercles. Thoracic glands enlarged ; no tubercles. T.B. very scanty.

G.-P.'s injected with E. of thoracic gland.

RABBITS [P.].

Number.	Duration of Life.	Result.
539	Killed, 374 days	Slight tuberculosis of peritoneum, lungs and kidneys. Tuberculosis of knee and ankle joint.
540	Killed, 374 "	Trace of tuberculosis in peritoneum.

Number.	Duration of Life.	Result.
727	Died, 47 days	G. T.
28	Died, 46 "	G. T.
729	Died, 15 "	T.

VIRUS H. 25. "A.T."

First "Passage" Experiment.

Strain derived from human lung, through G.-P. 1282.

JUNE 1, 1904.

E. of lesions from G.-P. 1282.

CALF 449.

Subcutaneous.

Dose : 87,273,000 T.B.

Killed : August 5, 1904.

(65 days.)

P.M.—Small local lesion, nearest glands caseo-calcareous. Small foci in thoracic and several peripheral glands

E. of prepectoral gland.

CALF 467.

Intravenous.

Dose : 11,248,000 T.B.

Killed : October 6, 1904.

(62 days.)

P.M.—One or more minute tubercles in lungs, liver, spleen ; numerous calcareous grains in thoracic glands, fewer in hepatic and right pre-scapular glands.

RABBIT 120 [Intrap.].

Killed : 97 days.

P.M.—Tuberculous peritonitis, very slight.

Experiment closed.

VIRUS H. 23. "J.P."

First "Passage" Experiment.

Emulsion of human lung.

March 19, 1905.

CALF 345.

Subcutaneous.

Dose : 103,093,000 T.B.

Killed : June 6, 1904.

(79 days.)

P.M.—Small local lesion ; caseating nodules in prescapular gland.

E. of prescapular gland.

CALF 441.

Intravenous.

Dose : 13,357,000 T.B.

Killed : September 16, 1904.

(102 days.)

P.M.—Generalized tuberculosis, not severe, calcareous and probably retrogressing. T.B. were not numerous in any of the lesions examined.

Experiment closed.

**Report (Submitted to the Commission in 1906) on
Experiments with Mixed Viruses**

H. 8. "S.C." (GROUP II.) and H. 10. "B.S." (GROUP I.), &c.

WHEN GROWN

- (1) In Artificial Culture.**
- (2) In the Body of a living Animal.**

BY

DR. L. COBBETT.

THE FATE OF MIXED VIRUSES.

Submitted to the Commission, July, 1906.

It was thought desirable to investigate experimentally the fate of mixtures of different kinds of tubercle bacilli for the following reasons.

In some experiments, detailed in the report on "The stability of virulence of tubercle bacilli in the living animal," a series of injections were made from calf to calf, starting with a virus belonging to our Group II.; and the strains of bacilli derived from the latter animals were different in cultural characters and specific virulence from those used at the commencement. This may, of course, have been the result of a modification of the bacilli in the body of a new animal host; but, on the other hand, it is possible that one had to do with a mixture of tubercle bacilli of the human and bovine types either from the commencement or at some stage of the experiment; and that the apparent modification resulting from a series of passage experiments, might after all be due to the elimination of one component of such a mixture of bacilli.

The hypothesis that in these cases one might have to do *at the outset* with a mixture of two kinds of tubercle bacilli arose out of the suggestion that the bovine bacillus might get access to the lesions caused by the human bacillus in man, and continue to live in them as "a harmless lodger"; that, for example in a case of tuberculous ulceration of the intestine, bacilli contained in milk given as food might not unreasonably be expected to get into the tuberculous lesions, and possibly travel to the mesenteric glands or even

further. In such a case an emulsion of, or a culture from, the tubercles might contain the bovine tubercle bacillus as well as the human (and therefore be virulent for the ox and rabbit) and yet the bovine bacillus be not the original cause of the lesions in the man.

The questions then which arose out of this consideration, and which it seemed desirable to investigate, were—

(1) Could evidence of virulence for the ox be trusted to prove that the lesions from which the infective material was obtained not only harboured but was caused by a bacillus virulent for the ox, that is, by the bovine bacillus; and (2) would the cultural characters of a strain of bacilli raised from this virulent material tell us whether or no the less virulent and eugonic human tubercle bacillus (Group II.) was absent, or present along with the bovine bacillus?

It was for these reasons very desirable to know more of the fate of mixed bovine and human tubercle bacilli both in the living animal and in culture, and since it was not permissible to use bacilli of bovine origin at Blythwood Farm it was decided to investigate the fate of mixtures of the bovine type of tubercle bacillus obtained from man, together with bacilli of the so called human type, that is the type commonly obtained from man, and which grows well on glycerin media and which is not virulent for the ox and rabbit.

For these experiments the virus H. 10 "B.S." was chosen as a typical example of the former, and H. 8. "S.C." as an equally typical example of the latter.

FATE OF MIXED VIRUSES IN ARTIFICIAL CULTURES.

The strains selected were (1) that obtained sixteen months previously, indirectly, from the human mesenteric glands of B.S. through the guinea-pig (it was then in its 12th generation of culture); and (2) that obtained directly from the mesenteric glands of S.C. more than two years earlier, and then in its 17th generation of culture.

The comparative virulence of these strains for calves and rabbits was redetermined and each found to correspond exactly to its class. Each was then sown on various media to determine the cultural characters as they then existed. It was thus found that each strain exhibited in a satisfactory manner the typical cultural characters of dysgonic and eugonic bacilli respectively. On pure serum they grew very similar to one another while on glycerin media the contrast was marked. On glycerin-serum, for example, B.S. at that time grew better than it had done when freshly isolated, and indeed as well as it did on pure serum. S.C., on the other hand while it grew no better than B.S. on pure serum, grew much more luxuriantly on glycerin serum, and rapidly formed large raised cream-coloured nodules. *It was obvious then that if each of these strains were to be grown mixed together and one did not interfere with the other, S.C. would have little if any advantage over B.S. as long as pure serum was the culture medium, but that it would have a very considerable advantage on glycerin-serum.*

Mixed cultures of these two strains were then sown with equal quantities of each upon (1) pure serum and (2) glycerin-serum, and a series of cultures on each of these media started, the cultures being resown once a month.

The first thing that was noticed was that these mixtures grew like cultures of S.C. alone; on glycerin media they were luxuriant, and yet bacilli belonging to the strain B.S. were present, as was shown by the result of injecting rabbits. *Mixtures then of eugonic and dysgonic bacilli grow like eugonic bacilli alone, the dysgonic bacilli being present also, but imparting no character to the appearance of the cultures by which they might be suspected.*

The next thing to determine was whether in a series of cultures started from such mixtures the dysgonic bacilli would persist, and if so for how long?

On pure serum a series of cultures was maintained for nine generations, and during a period of nine months. Six of these generations, including the last, were tested as to their virulence for the rabbit. All proved virulent for this species, producing fatal tuberculosis in a few weeks. All these nine generations of culture on pure serum contained along with the eugonic bacilli of the Group II. (human) strain, the dysgonic bacilli of the Group I. (bovine) strain, which alone are virulent to rabbits.

H. 8. "S.C." (HUMAN TYPE, OR GROUP II.) AND H. 10. "B.S." (BOVINE TYPE, OR GROUP I.).

Mixed Virus.

Immediate source of cultures used in the experiment:

H. 8. "S.C.": Original material (human mesenteric glands). Strain 2½ years old.

H. 10. "B.S.": Calf 113, through G.P. 757. Strain 1 year 4 months old.

Serum Series. [Controls.]

Subcultures 3 weeks old.

Rabbits injected intraperitoneally.

DOSE: 10 MILLIGRAMMES.

Number of Generations of the Mixed Culture.	Date.	Number of Rabbit.	Killed or Died.	Duration of Life in Days.	Result.
1st on serum	April 5, 1905	336	Died	27	General tuberculosis.
		337	"	25	General tuberculosis.
2nd on serum	April 18, 1905	360	"	20	General tuberculosis.
		361	"	86	General tuberculosis. (Nothing to account for prolonged ill- ness.)
3rd on serum	May 4, 1905	385	"	27	General tuberculosis.
		386	"	36	General tuberculosis.
4th on serum	May 24, 1905	422	"	16	General tuberculosis.
		423	"	26	General tuberculosis.
5th on serum	June 11, 1905	470	"	19	General tuberculosis.
		471	"	28	General tuberculosis.
9th on serum	December 5, 1905.	703	"	38	General tuberculosis.
		704	"	24	General tuberculosis, not severe. Death probably due to other causes.

Glycerin-Serum Series.

Subcultures 3 weeks old.

Rabbits injected intraperitoneally.

DOSE: 10 MILLIGRAMMES.

1st on glycerin-serum ...	April 5, 1905	338	Died	71	General tuberculosis of chronic type.
		339	"	101	Chronic tuberculosis, particularly affect- ing lungs.
2nd on glycerin-serum ...	April 18, 1905	362	"	97	Severe tuberculosis of chronic type affect- ing peritoneum and lungs, and kidneys (less severely). Injection (?) partly intracæcal.
		363	"	40	Slight tuberculous peritonitis. Severe tuberculosis of lungs and kidneys.
3rd on glycerin-serum ...	May 4, 1905	387	Killed	124	Chronic tuberculosis of peritoneum, lungs and kidneys, of the perlsucht type.
		388	"	124	Trace of tuberculosis in peritoneum. Tuberculosis of kidneys and lungs, the latter severely affected.
4th on glycerin-serum ...	May 18, 1905	399	Died	146	Tuberculosis of lungs. Trace in peri- toneum and kidneys.
		400	Killed	179	Trace of tuberculosis in omentum and kidneys.
5th on glycerin-serum ...	May 31, 1905	440	Died	141	Chronic general tuberculosis.
		441	Killed	166	Slight tuberculosis of lungs. Trace in peritoneum.
6th on glycerin-serum ...	June 14, 1905	472	Died	32	Slight tuberculous peritonitis in very small animal. Cause of death not determined.
		473	"	117	Trace of tuberculosis in peritoneum. Death from other causes.
On serum (after 5 on glycerin-serum).	June 14, 1905	474	"	67	Very slight tuberculous peritonitis. Trace in lungs and right kidney. Death from other causes.
		475	Killed	152	Trace of tuberculosis in peritoneum and kidneys.
10th on glycerin-serum...	November 14, 1905.	688	"	136	Trace of tuberculosis in peritoneum.
		689	"	136	Chronic tuberculous peritonitis.
On serum (after 9 on glycerin-serum).	November 14, 1905.	686	"	136	Trace of tuberculosis in peritoneum and kidneys.
		687	"	136	Trace of tuberculosis in peritoneum and one kidney.
11th on glycerin-serum...	December 5, 1905.	705	"	115	Trace of tuberculosis in omentum and one kidney.
		706	"	115	No tuberculosis.

On glycerin-serum the fate of the mixtures was quite otherwise. These went through eleven generations in the course of nine months. All the cultures were injected when three weeks old into rabbits, in 10 mg. doses. A large dose was chosen, because, while it was confidently held that even this quantity of S.C. bacilli could not cause death or progressive tuberculosis in these animals, it was thought more likely to reveal traces of the virulent B.S. bacilli if they were present.*

The first culture injected caused chronic progressive tuberculosis, both animals dying after several months. The virulent bacilli then were present, but probably in very small numbers.

The elimination of the bacilli virulent for the rabbit, although carried so far in the first culture on glycerin-serum, was not speedily completed, and traces of them remained for five generations, as was shown by the production of more or less progressive tuberculosis in rabbits injected with them. The elimination, however, became complete by the sixth generation, and rabbits injected with this as well as with the tenth and eleventh generations remained well for several months, and when killed were found to have only the minimal retrogressive lesions characteristic of the bacilli of S.C.

Thus the dysgonic (virulent) bacilli disappeared from the mixture when grown on a medium—glycerin-serum—which greatly favours eugonic bacilli (not virulent for rabbits) over dysgonic bacilli. The elimination was carried a long way in the first culture; but was not completed until several more generations had been grown. Why was it so rapid at first; so slow later?

A series of cultures of B.S. only on glycerin-serum was made to control the above. Though dysgonic at first, *i.e.*, growing badly on glycerin-serum, this strain rapidly adapted itself to the new soil, and after several generations grew almost like a typical eugonic strain. Hence in consequence of their ability to adapt themselves to glycerin media, the bacilli B.S. found themselves at a progressively diminishing disadvantage as compared with those of S.C. in succeeding cultures. And it is conceivable that they might never have died out completely had they been less dysgonic at the start, or able to adapt themselves a little more readily.

In the next series of experiments with a mixture grown on glycerin media, the virulent dysgonic element was not completely eliminated in six generations.

H. 9. "C.T." (HUMAN TYPE, OR GROUP II.) AND H. 14. "F.S." (BOVINE TYPE, OR GROUP I.).

Mixed Virus.

FIRST MIXED CULTURE SOWN ON JANUARY 17, 1905.

Immediate source of cultures used in the experiment :

H. 9. "C.T.": Calf 201, through G.P. 1,081. [4th Subculture. Strain 8 months old.]

H. 14. "F.S.": Calf 327, through G.P. 1,106. [3rd Subculture. Strain 7½ months old.]

GLYCERIN-SERUM SERIES.

Rabbits Injected Intraperitoneally.

No. of Generation of the Mixed Culture.	Date.	Number of Rabbit.	Dose in Milligrammes.	Killed or Died.	Duration of Life in Days.	Result.
On serum, after 5 generations on glycerin-serum. (5 weeks old sub-culture used for injection.)	Sept. 2, 1905.	589	10·0	Died	17	General tuberculosis.
		590	10·0	"	12	General tuberculosis.
		587	1·0	Killed	72	Chronic tuberculosis of lungs and kidneys. (Injection intramuscular.)
		588	1·0	Died	25	General tuberculosis.
On serum, after 6 generations on glycerin-serum. (3 weeks old sub-culture used for injection.)	Nov. 8, 1905.	674	10·0	"	24	General tuberculosis.
		675	10·0	"	19	General tuberculosis.
		676	1·0	"	25	General tuberculosis.
		677	1·0	"	26	General tuberculosis complicated by other disease.

In both of the experiments just described the series of mixed cultures on glycerin media diminished its virulence for the rabbit, and in the case of the first, ultimately lost it. How, it may be asked, is it certain that this was due to elimination and not to attenuation? In the report on the stability of virulence of tubercle bacilli (*see page 299*) there is collected much evidence of the great stability of virulence of tubercle bacilli in general and a complete refutation of the suggestion that glycerin in the culture medium causes attenuation. Moreover, the virulence of a series of cultures of the strain B.S. itself on glycerin-serum was tested in order to form a control to the experiments

with mixture. The series went through ten generations of culture on glycerin-serum, and its virulence was maintained unaltered to the end; even so small a dose as ·01 mg. of the last culture proving fatal to two rabbits in five or six weeks. The table of these experiments is reprinted here for convenience of reference. These experiments show the possibility of separating tubercle bacilli of the human type from mixtures of bacilli of the bovine and human types by a series of cultivations on glycerin media; but they show also that this method succeeds only when the cultural characters of the bovine type of bacillus are markedly dysgonic.

* It must be remembered that very minute doses of tubercle bacilli belonging to Group I. suffice to cause fatal tuberculosis in the rabbit.

VIRUS H. 10. "B.S."

Rabbits Injected Intraperitoneally.

CULTURE DERIVED FROM CALF 113, THROUGH G.P. 757.

[Strain 16½ months old at commencement of experiment.]

CULTURES ON PURE SERUM (BOVINE).

Culture 3 weeks old, sown February 22, 1905, from pure Serum Culture. Inoculated March 15, 1905.

Number of Rabbit.	Dose in Mg.	Killed or Died.	Duration of Life in Days.	Result.
298	10.0	Died	21	G.T.
297	1.0	"	23	G.T.
296	0.1	"	44	G.T.
295	0.01	"	78	G.T.

Sown May 17, 1905, on Serum, from the 3rd Culture on Glycerin-serum. Inoculated June 7, 1905.

452	10.0	Died	37	G.T. (Injection partly intramuscular.)
453	1.0	"	13	G.T. Death perhaps hastened by psorospermiosis.
454	1.0	"	28	G.T.
455	0.1	"	92	Chronic T. of lungs. (Injection intracæcal.)

Sown June 30, 1905, on Serum, from the 5th Culture on Glycerin-serum. Inoculated July 21, 1905.

525	10.0	Died	73	G.T. (Injection probably partly intracæcal.)
526	1.0	"	53	G.T.
527	1.0	"	21	G.T.
528	0.1	"	1	Death due to psorospermiosis.

Sown August 7, 1905, on Serum, from the 7th Culture on Glycerin-serum. Inoculated August 28, 1905.

555	10.0	Died	19	G.T.
556	10.0	"	17	G.T.
557	1.0	"	24	G.T.
558	1.0	"	28	G.T.

Sown October 24, 1905, on Serum, from the 9th Culture on Glycerin-serum. Inoculated November 14, 1905.

682	10.0	Died	80	G.T. (Injection partly subcut.)
683	1.0	"	29	G.T. Not very severe.
684	0.1	"	29	G.T.
685	0.01	"	43	G.T. (Injection partly intracæcal.)

CULTURES ON 5 PER CENT. GLYCERIN-SERUM (BOVINE).

Culture 3 weeks old, sown April 27, 1905, from the 1st Culture on Glycerin-serum. Inoculated May 18, 1905.

Number of Rabbit.	Dose in Mg.	Killed or Died.	Duration of Life in Days.	Result.
401	10.0	Died	17	G.T.
402	1.0	"	39	G.T. (Injection partly sub-peritoneal.)
403	0.1	"	26	G.T.

Sown October 24, 1905, on Glycerin-serum, from the 9th Culture on the same medium. Inoculated November 14, 1905.

678	10.0	Died	16	Early G.T.
679	1.0	"	21	G.T.
680	0.1	"	25	G.T.
681	0.01	"	38	G.T.

FATE OF MIXED VIRUSES IN THE LIVING ANIMAL.

The fate of mixed viruses in the living animal was investigated by injecting rabbits and calves with mixtures of strains of tubercle bacilli belonging to the human Groups I. and II. (*i.e.* human and bovine types of tubercle bacilli, each derived from man) and then studying the cultural characters of new strains derived

from the metastatic lesions which developed in the animals; it being held that if these were distinctly eugonic one might conclude that the eugonic element (which has but slight virulence for the ox and rabbit) of the mixture had reached a metastatic lesion caused by the dysgonic (virulent) element.

FATE OF MIXED VIRUSES IN THE RABBIT.

EXPERIMENT WITH H. 33. "R.T." AND H. 32. "Y.W."

Rabbit 257 received on January 21, 1905, an intraperitoneal injection of 10 mg. of a mixed culture on glycerin-serum. This had been sown first with H. 32. "Y.W." (dysgonic type) on December 31, 1904, from the 5th serum culture derived directly from the human mesenteric glands, and 10 days later it was again sown, this time from the 7th serum culture of H. 33 "R.T." (eugonic type) derived directly from human axillary glands.

After the culture had been allowed to grow for 28 days after the last sowing, and when it was growing luxuriantly in the manner of H. 33. "R.T." it was injected.

The rabbit died of general tuberculosis 48 days later, and cultures were sown from the lung, and from the marrow of one of the ribs.

It will be remembered that tubercle bacilli of the kind to which H. 33. "R.T." belongs frequently cause unimportant lesions in the lungs of rabbits, but have seldom if ever been known to cause lesions in the liver, spleen, or bone marrow; while those of the H. 32. "Y.W." kind constantly cause general tuberculosis in these animals. Consequently, it would be less surprising to find tubercle bacilli of the "R.T." kind in the lungs of a rabbit injected with a mixture, than in the marrow or spleen.

This particular experiment turned out according to anticipation. A clear difference soon showed itself between the two sets of cultures. Those from the lung cultures grew luxuriantly on glycerin-serum and on glycerin-agar, just as H. 33. "R.T." had done. The rib cultures, on the other hand, grew no better on serum, with glycerine than without. Sown from glycerin-serum on to the same medium its growth did not increase, and the strain retains its dysgonic characters down to the present time (July, 1906).

There can be little doubt, therefore, that in this case the non-virulent eugonic H. 33. "R.T." either did not reach the bone marrow, or could not live there, while it gained access to the lung along with the dysgonic virulent H. 32. "Y.W." and remained alive there until the animal died on the 48th day. *The less virulent element therefore does not necessarily always accompany the more virulent element of an injected mixture wherever the latter goes.*

EXPERIMENT WITH "S.C." AND "B.S."

Rabbit 336 received on April 5, 1905, an intraperitoneal injection of 10 mg. of a serum culture, sown 21 days before with equal parts of "S.C." and "B.S."

It died 27 days later with general tuberculosis. Cultures were sown from the bone marrow of a rib, and from the lung.

The culture from the marrow grew rapidly and well on the primary serum culture, and in subculture on glycerin-serum grew large raised cream-coloured but not confluent colonies—that is like "S.C." and unlike "B.S." The cultures from the lung also grew well on glycerin-serum, but a culture on serum-agar failed. There is evidence, then, that in this animal "S.C." reached the bone marrow as well as the lung.

Rabbit 337 received an injection similar to the above, and at the same time. It died of general tuberculosis 27 days later. Cultures were sown from the mesentery, marrow and sternal gland. Those from the mesentery were intended to act as controls to the others, for it was held that "S.C." would be certainly recovered along with "B.S." from the peritoneum.

All three cultures grew large raised cream-coloured colonies on glycerin-serum. These did not fuse

together to any great extent, nor did the growth mount up the side of the glass, but this was probably because there was very little excess of fluid in the tubes. There was no difference between the three sets of cultures. All, in fact, grew just like "S.C." and unlike "B.S." and there can, I think, be no reasonable doubt that in this animal, as in the last, the non-virulent eugonic "S.C." reached the marrow of the ribs and the sternal glands.

Rabbit 299 received on March 15, 1905, an intraperitoneal injection of 5 mg. of "S.C." and 5 mg. of "B.S." grown separately on pure serum for 21 days. It died of general tuberculosis 16 days later. Cultures were sown from the lung and from the marrow of a rib.

The primary culture from the lung grew on glycerin-serum with a thick, wrinkled, cream-coloured film, and in subsequent cultures it always grew luxuriantly on that medium (with the exception of a batch of tubes of serum from Cow 95, on which other eugonic cultures failed to develop characteristic growths).

Of two broth cultures from the lung, one was very fairly eugonic, the other only moderately so.

A litmus milk glycerin culture grew fairly well, and ended more acid than it began.

The primary culture from the marrow grew well on serum (it is not recorded whether a primary serum glycerin culture was sown or not). In the first subculture of glycerin-serum it grew in large thick, whitish colonies, with raised and nodular margins (eugonic). Then followed a number of cultures on the unsatisfactory serum of Cow 95. And finally, some cultures sown in June from the primary culture of March 31. One of these, on glycerin-serum, grew in a continuous cream-coloured nodular film. The other was not quite so characteristic.

A broth culture grew a continuous film, but it was of the smooth ground glass kind, and not characteristically eugonic. A litmus milk glycerin culture however grew very well, like H. 9. "C.T." Calf 201, and ended distinctly more acid than it began.

It is fairly certain, therefore, that in this case also the eugonic non-virulent "S.C." was found in the rib marrow.

Thus in three out of four instances where a rabbit was injected with a mixture of dysgonic bacilli which are virulent for its species, and eugonic bacilli which are only slightly so, the latter were found (no doubt along with the former) in the metastatic lesions, not only in the lung, but also in the bone-marrow.

The evidence of this was based on the cultural characters of the strains of bacilli raised from these lesions. But in order to put the evidence on a wider and more objective foundation another method was used in addition.

It has already been stated that when a mixture of virulent (for calves and rabbits) dysgonic bacilli, which grow badly on glycerin media, are grown along with non-virulent (for these animals) eugonic bacilli which grow luxuriantly on these media, the former are placed at a disadvantage, and rapidly tend to disappear from the mixture, until at last only the non-virulent eugonic bacilli may remain.

That this is a true elimination and not an attenuation was shown by the fact that "B.S." as well as many other pure strains are not attenuated when grown for many generations on glycerin media.

These results suggested a method which may be applied to answer the question, as in the present case, whether a non-virulent bacillus is existing in a culture side by side with a virulent bacillus; for if after growing for several generations on glycerin-serum the strain should be found non-virulent for rabbits, since

one cannot admit that it has been attenuated, one can only conclude that a non-virulent element was originally contained in the strain and that this alone has been left.

In accordance with the reasoning a culture from the

rib-marrow of Rabbit 299 was grown for three generations on glycerin-serum, and finally on pure serum. This last culture when three weeks old was injected into the peritoneal cavity of rabbits as follows:—

STRAINS OF CULTURE DERIVED FROM THE RIB MARROW OF RABBIT 299.

Glycerin-Serum Series.

Sub-culture three weeks old. Rabbits inoculated intraperitoneally.

	Total Duration of Artificial Cultivation.	Medium on which Final Culture was Grown.	Dose in Milligrammes.	Number or Rabbit.	Killed or Died.	Duration of Life in Days.	Result.
Grown for 3 generations on glycerin-serum media.	8½ months	Pure serum	10.0	731	Killed	109 days	Slight tuberculosis of peritoneum. Trace in lungs.
			10.0	732	Killed	109 days	Trace of tuberculosis in peritoneum and kidneys.
			1.0	733	Killed	109 days	Trace of tuberculosis in peritoneum.
			1.0	734	Killed	109 days	Trace of tuberculosis in peritoneum and kidneys.

As will be seen from the accompanying table the results of these injections were in all cases minimal; not even did the very large dose of 10 mg. cause general or progressive tuberculosis. Indeed, the result clearly demonstrated that after three generations of growth on glycerin-serum, only a bacillus incapable of seriously infecting rabbits was left, and there can be no reasonable doubt from what has gone before that this was the Group II. strain "S.C." and therefore the conclusion may be held to be confirmed, namely, that *bacilli of Group II. may be found in metastatic lesions*

caused by other tubercle bacilli, after injection of both kinds of bacilli into animals in which the former kind are incapable of producing such lesions. But they are not necessarily found in these lesions as the experiment with H. 33, "R.T." and H. 32 "Y.W." showed.

This conclusion is, of course, not a surprising one, seeing how wide spread (though not progressive) are the lesions produced by bacilli of Group II. in this species. And remembering too that in the even more highly resisting calf bacilli of this kind become universally distributed after an injection.

FATE OF MIXED VIRUSES IN THE CALF.

For these experiments the strains used were "S.C." and "B.S.," the same which had been employed for determining the fate of mixed viruses in artificial culture; and the first calves were injected with the actual cultures used for sowing the first tubes of the mixed culture series.

On March 15, 1905, two calves were subcutaneously injected, each with 50 mg. of "B.S." and 50 mg. of "S.C.": serum cultures which had been grown 21 days. In the case of Calf 689 the "S.C." and the "B.S." bacilli were mixed and injected together subcutaneously on the right side of the neck. In Calf 649 the two kinds of bacilli were injected separately, one on each side of the neck.

Calf 689 became very ill and was killed on May 2—48 days after injection. It was found to have general tuberculosis, but the great organs, other than the lungs, were not affected severely.

Another calf (757) was then injected subcutaneously with an emulsion made of the lung of 689.

From Calf 689 cultures were grown from (1) the prescapular gland (this as a control to the rest); (2) the long thoracic gland; (3) the spleen; and (4) the lung. The first three were obtained direct from the organs from the calf, but the fourth failed, and had to be recovered from a guinea-pig which had been injected with a lung emulsion.

These strains as well as others from other animals injected for a similar purpose were studied through many generations on various media. Somewhat unfortunately there were so many of them that it was difficult or impossible to find the time, amid the many other pressing claims of the Blythwood laboratory, for the through study of their cultural characters. And many opportunities of following up strains from

particular colonies, were unfortunately lost. If then the results of this part of the investigation were not as definite as could be wished, it is because for such an investigation one's whole time is required, and not merely what can be spared from other work.

Of the cultures from Calf 689 none grew in the manner characteristic of a virus of Group II. such as "S.C.," but occasionally a eugonic feature was noticed. These, however, were so much the less significant, seeing that "B.S." the dysgonic constituent of the mixture of cultures used, had been grown for long on artificial media, and had thereby acquired a considerable luxuriance of growth.

Among the cultures from the prescapular gland one on glycerin-serum showed a large eugonic colony heaped up and wrinkled, amidst a poor growth of small colonies. Another culture on the same medium grew many large raised cream-coloured colonies. This growth might have passed for one of "S.C." but was not typical of "S.C." at its best, while it was itself the best produced by this strain; moreover, subcultures from it did not grow like "S.C." Unfortunately, at this stage the strain was lost.

Of the cultures from the thoracic gland, two produced, on glycerin-serum, largish raised cream-coloured colonies like "S.C.," but not quite characteristic. A third subculture grew like "B.S.," not at all like "S.C.," and so also did glycerin-agar and broth cultures.

Of the cultures grown from the spleen, a third subculture on glycerin-serum was fairly characteristic of "S.C." Some of the earlier cultures, also on glycerin-serum, grew somewhat like "S.C." but not characteristically. A fourth culture, the second on glycerin-serum (from the ox) grew in large raised white colonies,

a similar culture on glycerin-serum (from the dog) grew very definitely in large and small colonies. Glycerin-agar cultures, however, were not eugonic.

Of the cultures obtained indirectly from the lung through guinea-pigs, none have grown like "S.C.," but all might well be "B.S." without admixture. On agar one culture alone grew, and that only moderately. On the other hand, on broth added to the serum cultures vigorous growth took place.

The cultures from Calf 689 then on the whole were not like those of "S.C." nor yet like mixed cultures of "B.S." and "S.C." in anything like equal proportions. Yet now and then an occasional eugonic character had suggested there might be a trace of "S.C." in a culture which was composed almost entirely of "B.S." And indeed if "S.C." were present at all in the metastatic lesions of the calf, it was not reasonable to expect them to be present in anything more than very small numbers.

Accordingly steps were taken to grow the culture under conditions which would favour any trace of "S.C." that might be present, and cause it to become evident. For this purpose the various strains from the calf were grown for several generations on glycerin-serum. Since the dysgonic "B.S." improved itself in luxuriance of growth when grown on glycerin-serum, it was necessary to compare these strains with a series of cultures of "B.S." on the same medium.

On this medium the strains of bacilli from the calf

improved in luxuriance of growth and approximated to cultures of "S.C." alone, nevertheless they were not so superior to the series of cultures of "B.S." alone on this medium that one could draw any safe conclusions from these cultural characters.

Calf 649, as stated above, was injected on March 15, 1905 with 50 mg. of "S.C." culture on one side of the neck and 50 mg. of "B.S." on the other. It was killed when dying, 41 days later, and was found to have general tuberculosis. Cultures were raised from the great thoracic gland, renal lymph gland, and spleen.

The culture from the great thoracic gland cannot be considered eugonic. Its growth on glycerin-serum was no better than that of "B.S." itself at this period, and it failed to grow on agar. It is true that it quickly learnt to grow well in a series of glycerin-serum culture, but without any marked superiority over a similar series of "B.S." cultures.

The cultures from the renal gland and the spleen were similar to those from the prescapular gland, with the important exception that on one of the agar tubes from the spleen two large pyramidal wrinkled colonies appeared, strains raised from which are now being followed up.

It has been stated above that large and small colonies were seen on a glycerin-serum tube sown with the strain derived from the spleen of Calf 689. Serum cultures sown from each variety of colonies were injected into rabbits. Both proved fully virulent.

VIRUS H. 8. "S.C." (Group II.)
VIRUS H. 10. "B.S." (Group I.)

CALF INJECTIONS. MARCH 15, 1905.

- [H. 8. "S.C." Strain derived from human mesenteric glands direct.]
Subculture used, 21 days old.
- [H. 10. "B.S." Strain derived from Calf 113, through G.-P. 757.]
Subculture used, 21 days old.

BULL-CALF 649.
Subcutaneous.
Dose : 50 mg. "S.C." on left side, 50 mg. "B.S." on right side, prescapular region.
Killed, when dying: April 25, 1905.
41 days.
P.M. — General tuberculosis, severe.

RABBIT [Intraperitoneal].
Dose : 5 mg. each of "S.C." and "B.S." mixed before injection.

Number.	Duration of Life.	Result.
299	Died, 16 days	Acute tuberculosis. ? any other cause of death.

BULL-CALF 689.
Subcutaneous.
Dose : 50 mg. "S.C.," 50 mg. "B.S.," mixed before injection.
Killed, when very ill : May 2, 1905.
48 days.
P.M. — General tuberculosis.

GUINEA-PIGS [Intraperitoneal].

	Number.	Duration of Life.	Result.
E. of prescapular gland of Calf 689.	531	Died, 30 days	G. T.
	532	" 24 "	G. T.
E. of thoracic gland	533	" 25 "	G. T.
	534	" 30 "	G. T.
E. of renal gland ...	535	" 18 "	G. T.
	536	" 28 "	G. T.
E. of lung ...	537	" 35 "	G. T.
	538	" 29 "	G. T.

BULL-CALF 757.
Subcutaneous.
Emulsion of lung.
Dose : 85,340,000 T.B.
Killed, when very ill : June 24, 1905.
53 days.
P.M. — General tuberculosis, moderately severe.

STRAIN OF CULTURE DERIVED FROM THE SPLEEN OF CALF 689.

Separation of Colonies on a Glycerin Medium.

Sub-cultures three weeks old. Rabbits inoculated intraperitoneally.

	Total Duration of Artificial Cultivation.	Medium on which Final Culture was Grown.	Dose in Milligrammes.	Number of Rabbit.	Killed or Died.	Duration of Life in Days.	Result.
Sub-strain of culture, 5 months old, raised from a large colony on a glycerin - serum medium.	12½ months	Pure serum	10.0	883	Died	89 days	General tuberculosis (injection partly intracæcal).
			1.0	884	Died	28 days	General tuberculosis.
			1.0	885	Died	28 days	General tuberculosis.
			1.0	881	Died	15 days	General tuberculosis, acute.
Sub-strain of culture, 5 months old, raised from a small colony on a glycerin - serum medium.	12½ months	Pure serum	1.0	882	Died	27 days	General tuberculosis.
			1.0				

On the whole then the cultural characters of the strains of tubercle bacilli raised from this calf, injected with mixed cultures, even that from the gland nearest to the seat of injection, were such as to afford no definite evidence of the presence of the bacilli of Group II. in the lesions produced in this animal by the bacilli of Group I. On the other hand, it cannot be affirmed that evidence of this was entirely absent, and some of the cultures developed colonies on glycerin-serum which suggested that a few bacilli of this kind were present. If strains from these colonies had been followed up, it is possible that the presence of bacilli of the virus belonging to Group II. might have been demonstrated.

Calf 757 was injected subcutaneously with an emulsion of the tuberculous lung of Calf 689, in order to see whether bacilli of Group II. as well as those of Group I. would be thereby communicated. It was probably a mistake to choose the lung rather than some other organ containing metastatic lesions, because tubercle bacilli have not infrequently been found in the lungs of calves even three months after subcutaneous injection of bacilli of Group II. But at the time this was not known.

This calf became very ill, and was killed 53 days after injection. It was found to have general tuberculosis. Cultures were sown from the local lesion, prescapular gland, long thoracic gland, lung and spleen. They were, on the whole, rather variable and difficult to interpret.

Those from the local lesion were very fairly eugonic on glycerin-serum, and became markedly so after growing for several generations on this medium. They grew but little, however, on glycerin-agar.

Those from the prescapular gland were moderately eugonic on glycerin-serum, but grew, like the above, but little on glycerin-agar. One of the cultures on glycerin-serum showed very distinctly two kinds of

growth—a ground-glass layer studded with large raised white colonies.

The cultures from the spleen were at first only moderately eugonic on glycerin-serum, but became fairly so after several generations of growth on that medium.

They failed to grow on glycerin-agar.

The lung cultures were not eugonic on glycerin-serum, and they did not become so even after five generations of growth on that medium. They did not grow on glycerin-agar.

The cultures from the long thoracic gland were very fairly eugonic on glycerin-serum at the start, and became markedly so after growing for several generations on that medium. A glycerin-agar culture grew a single large wrinkled pyramidal colony, which afterwards became surrounded with daughter colonies; this particular culture, at least, was typically eugonic. Other glycerin-agar cultures grew less well or not at all.

Therefore, judging from the cultural characters of the strains of tubercle bacilli raised from the various metastatic lesions in this calf, it seems probable that the virus "S.C." (Group II.), reached some of the metastatic lesions caused by the virulent virus "B.S.", but not all (*e.g.*, the lungs). But the cultural characters were not sufficiently definite to amount to conclusive evidence. Accordingly, a strain showing fairly eugonic characters, namely, that from the long thoracic gland of the calf, was chosen and its virulence tested after it had been grown for five generations on glycerin-serum, in order to see whether the virulent element ("B.S.") could be eliminated, and the non-virulent ("S.C.") put in evidence, as had been done with some of the cultures raised from the rabbits injected with virulent viruses.

The final cultures were grown on pure serum and injected when three weeks old. The injections were intended to be intraperitoneal, but in two instances they were found to have been more or less intramuscular.

STRAIN OF CULTURE DERIVED FROM THE LONG THORACIC GLAND OF CALF 757.

Glycerin-Serum Series.

Sub-culture three weeks old. Rabbits inoculated intraperitoneally.

	Total Duration of Artificial Cultivation.	Medium on which Final Culture was Grown.	Dose in Milligrammes.	Number of Rabbit.	Killed or Died.	Duration of Life in Days.	Result.
Grown for 5 generations on glycerin-serum media.	6½ months	Pure serum	10.0	763	Died	23 days	General tuberculosis (injection partly intramuscular).
			1.0	764	Died	80 days	General tuberculosis (injection intramuscular).
			1.0	765	Died	42 days	General tuberculosis.
			1.0	766	Died	23 days	General tuberculosis.

All the rabbits died of general tuberculosis. The long duration of life in No. 764 was accounted for by the injection having been entirely intramuscular. These results proved the strain highly virulent for rabbits, and showed that the "S.C." bacilli had not been isolated. They therefore afford no evidence of their presence. And one must conclude either that bacilli belonging to the Group II. Virus "S.C." were not present in the metastatic lesions of the Calf 757. Or that, if they were, our methods had failed to demonstrate them.

Calf 649 was injected with 50 mg. of culture of the bacilli belonging to the virus "B.S." (Group I.) on one side of the neck and an equal quantity of culture of the bacilli belonging to "S.C." (Group II.)

on the other. It became very ill, and when killed 41 days after injection was found to have general tuberculosis.

Cultures were raised from the great thoracic gland, renal lymphatic gland, and spleen. Those from the great thoracic gland grew no better on glycerin-serum than did control cultures of "B.S." only at this period, and they did not grow on glycerin-agar.

The cultures from the renal gland were like those from the long-thoracic; and so, in general, were those from the spleen; but on one of the glycerin-agar tubes two large pyramidal and wrinkled colonies arose. A substrain was raised from one of these and injected into rabbits, but it proved fully virulent, thus affording no evidence of the presence of bacilli belonging to the virus "S.C." in the lesions of this calf.

STRAIN OF CULTURE DERIVED FROM THE SPLEEN OF CALF 649.

"Separation of Colonies" on a Glycerin Medium.

Sub-culture three weeks old. Rabbits inoculated intraperitoneally.

—	Total Duration of Artificial Cultivation.	Medium on which Final Culture was Grown.	Dose in Milli- grammes.	Number of Rabbit.	Killed or Died.	Duration of Life in Days.	Result.
Sub-strain of culture 1 month old, raised from a large wrinkled colony on a glycerin-agar medium.	13 months	Pure serum	10.0	900	Died	14 days	Early general tuberculosis.
			10.0	901	Died	19 days	General tuberculosis.
			1.0	902	Died	115 days	General tuberculosis (injection partly intracaecal).
			1.0	903	Died	28 days	General tuberculosis.

SUMMARY.

These experiments proved that in rabbits injected with mixed cultures of bacilli belonging to both our human groups, the bacilli which are slightly virulent for the species may be found in metastatic lesions. This is not surprising seeing how commonly bacilli of Group II. cause metastatic lesions in these animals, although the lesions are as a rule trivial and very seldom progress.

In calves injected with mixed cultures, no satisfactory evidence was obtained of the presence of bacilli

belonging to Group II. in the metastatic lesions caused by injecting mixtures of bacilli of both groups. But on the other hand the absence of these slightly virulent bacilli from such lesions was not proved.

These experiments show that when mixtures of the human and bovine types of tubercle bacilli are passed through a series of animals which are very susceptible to the attack of the latter and only slightly so to that of the former type of bacilli, the former may become, but probably not necessarily, eliminated.

POST-MORTEM NOTES OF CALVES USED IN THE "MIXED VIRUS" EXPERIMENTS.

CALF 649.

Subcutaneous Inoculation of (1) 50 milligrammes of culture derived from Calf 113, H. 10. "B.S." ; (2) 50 milligrammes of culture derived from human mesenteric glands, H. 8. "S.C."

The former was injected on the right side of the neck, the latter on the left.

Date—March 15, 1905.

Killed when dying—April 25, 1905. [41 days after inoculation.]

Weights.

			qrs.	lbs.
March 15, 1905	...	...	3	17
April 25, 1905	...	...	3	10

Total loss of weight.—7 lbs.

Rate of loss per week.—1.15 lbs.

Thoracic Glands.—Were all much enlarged, and were caseo-necrotic throughout.

Heart.—Contained a single minute tubercle in the right auricle, and a tubercle (?) on one of the cordae.

Abdomen.

Intestines.—The small intestine contained small yellow solid caseous points, sparsely but widely scattered.

Mesenteric Glands.—Were almost all slightly affected, containing one or more shot-sized caseating tubercles.

Spleen.—Contained a moderate number of rather large (large shot sized) tubercles.

Liver.—The liver was spotted moderately thick with tubercles, which did not exceed $\frac{1}{8}$ in. in diameter, and many similar tubercles were seen on section.

Hepatic Glands.—Were enlarged and were entirely composed of tuberculous tissue, grey and translucent, with caseous points and networks.

Kidneys.—Contained small tubercles and groups of minute tubercles in their cortices, several in each lobule.

Suprarenals.—Normal.

Renal Glands.—Were severely affected. They contained a few tubercles, which were rather larger than usual, reaching a size of $\frac{1}{8}$ or $\frac{1}{4}$ in., and were distinctly caseating.

Lumbar Glands, Iliac Glands.—Resembled the renal glands, but were not so severely affected.

Special Glands.

Precrural, Gluteal, Right Popliteal, Submaxillary, Parotideal, Post-Pharyngeal, Hyoid.—Contained a few tubercles, which were rather larger than usual, reaching a size of $\frac{1}{8}$ or $\frac{1}{4}$ in., and were distinctly caseating.

Tonsils.—One tonsil contained a tuberculous focus.

Microscopical Examination.

Emulsion of Spleen, Emulsion of Thoracic Gland, Emulsion of Right Renal Gland, Emulsion of Lung, Tubercle from Intestine.—Tubercle bacilli numerous in the smear preparations from all these sources.

POST-MORTEM EXAMINATION.

General Condition.—Thin.

Local Lesion.—At the seat of inoculation, on the right side of the neck ("B.S. inoculation"), was a flattened solid tumour, 4 in. by 3 in., which infiltrated skin and subjacent muscle, and was principally composed of dense caseo-necrotic tissue, which contained small irregular cavities with serous contents.

Right Prescapular Gland.—Was enlarged, $3\frac{1}{4}$ in. by $1\frac{1}{2}$ in., and was caseo-necrotic throughout.

Right Prepectoral Gland.—Was as large as a cherry, and was similarly affected.

Local Lesion.—At the seat of inoculation, on the left side of the neck ("S.C. inoculation"), was a very small swelling $1\frac{1}{2}$ in. by $1\frac{1}{4}$ in., composed of a caseous and partly softened mass, which did not infiltrate skin or subjacent muscle.

Left Prescapular Gland.—Was scarcely at all enlarged, and, like the great majority of other glands, contained a few caseous tubercles.

Left Prepectoral Gland.—Contained a single tubercle.

Prepectoral Glands, Right Deep Cervical Glands.—Contained a few tubercles, which were rather larger than usual, reaching a size of $\frac{1}{8}$ in. to $\frac{1}{4}$ in. and were distinctly caseating.

Thorax.

Pleura.—Was not affected.

Lungs.—Contained many small caseous tubercles, with translucent dark red margins. The anterior lobes were collapsed, and here the tubercles appeared whitish. Small areas of collapse occurred also in other parts of the lung. Section showed the tubercles to be scattered everywhere, and also revealed small rectilinear solid and partly caseous patches, evidently tuberculous lobes.

CALF 689.

Subcutaneous Inoculation on the right side of the neck of 100 milligrammes of culture, consisting of 50 milligrammes each of culture of H. 8. "S.C.," and of H. 10. "B.S.," mixed before injection.

Date—March 15, 1905.

Killed, when very ill—May 2, 1905. [48 days after inoculation.]

Weights.

			qrs.	lbs.
Weight at inoculation	...	...	3	26
Weight at death	...	...	3	21

Total loss of weight.—5 lbs.

Rate of loss per week during experiment.—0.7 lb.

POST-MORTEM EXAMINATION.

General Condition.—Thin.

Local Lesion.—At the seat of inoculation, on the right side of the neck, was a flat tumour, 5 in. by 3 in., which infiltrated the skin and subjacent muscle. It was principally composed of tough salmon pink

caseo-necrotic tissue, and contained an irregular cavity filled with serous fluid.

Right Prescapular Gland.—Measured $3\frac{1}{4}$ in. by 2 in. Its cortex was almost entirely composed of dense salmon pink caseo-necrotic tissue.

Left Prescapular Gland.—Was slightly affected, and contained only a few small insignificant foci.

Right Prepectoral Gland.—The size of a cherry, and resembled the right prescapular in structure.

Pectoral Glands.—Right pectoral glands were enlarged and their cortices firm and somewhat gelatinous, with early caseating foci.

Axillary Glands.—Resembled the left prescapular.

Cervical Glands.—The deep cervical lymphatic glands were only slightly affected.

Thorax.

Pleura.—Normal.

Lungs.—The lungs were packed with rather large tubercles up to an eighth of an inch in diameter, with a pinkish grey irregular margin, and a relatively large caseous centre. A portion of the anterior lobes was dark red in colour and consolidated. Tubercles were uniformly and thickly scattered throughout the lung substance. The bronchi were full of mucus.

Trachea.—Normal.

Thoracic Glands.—Were enlarged and somewhat gelatinous. Their cortices were everywhere transformed into translucent grey tuberculous tissue, packed with early caseating foci.

Heart.—Normal.

Abdomen.

Peritoneum, Omentum.—Normal.

Intestines.—The intestines everywhere contained numerous whitish foci up to an eighth of an inch in diameter, which could be seen plainly from the peritoneal surface, and also from the mucous surface. These were definitely caseating. In some of the Peyer's patches the caseating foci were commencing to ulcerate.

In the cæcum the crowded solitary follicles were swollen and pink, and each had a central depression. Foci could be seen in the large intestine similar to those in the small intestine, but they were less numerous.

Mesenteric Glands.—Were swollen to about double their normal size, were firm and gelatinous, and their

cortices were almost universally converted into translucent grey tissue, which contained a yellowish network and small caseating islands.

Spleen.—Contained only a moderate number of small tubercles.

Liver.—No tubercles could be seen in the liver.

Hepatic Glands.—Were similar to the thoracic.

Kidneys.—One small tubercle was seen in the right, two in the left. About the pelvis of the left kidney, and the left ureter, was a large amount of oedema.

Suprarenals.—A tubercle was found in one; the other was normal.

Renal Glands, Lumbar Glands.—Resembled the mesenteric glands, but were in a less advanced stage.

Iliac Glands.—Were slightly affected, and contained only a few small insignificant foci.

Ischiatic Glands.—Normal.

Genito-Urinary System.

Testes.—Normal.

Special Glands.

Precural, Right Gluteal.—Were slightly affected, containing only a few small insignificant foci.

Left Gluteal.—Normal.

Popliteal.—Resembled the precural and right gluteal.

Left Submaxillary.—Was only slightly affected.

Right Submaxillary, Parotideal, Pharyngeal.—Were rather more severely affected, with caseous foci.

Hyoid.—Were only slightly affected.

Tongue, Palate, Tonsils, Pharynx, Larynx.—Normal.

Microscopical Examination.

Emulsion of Lung, Emulsion of Spleen, Prescapular Gland, Thoracic Gland.—Tubercle bacilli numerous.

Renal Gland.—Tubercle bacilli.

Mucus from Bronchi.—Tubercle bacilli.

Tubercle from Small Intestine.—Tubercle bacilli numerous.

Tubercle from Cæcum.—A few tubercle bacilli.

Rib Marrow.—No tubercle bacilli.

CALF 757.

Subcutaneous Inoculation on right side of neck, of emulsion of lung of Calf 689, the first calf of the series.

Date of Inoculation—May 2, 1905.

Dose—85,340,000 tubercle bacilli.

Killed, when very ill—June 24, 1905. [53 days after inoculation.]

Weight.

			cwt.	qrs.	lbs.
May 2, 1905	..	...	1	0	7
June 24, 1905	..	...	0	3	14

Total loss of weight.—21 lbs.

Rate of loss per week.—2·7 lbs.

POST-MORTEM EXAMINATION.

General Condition.—Thin.

Local Lesion.—At the seat of inoculation, on the

right side of the neck, was a tumour which measured $4\frac{1}{2}$ in. by 4 in. It was caseo-necrotic throughout, and infiltrated skin and subjacent muscle.

Right Prescapular Gland.—Was much enlarged. It measured 4 in. by $2\frac{1}{2}$ in. by $1\frac{3}{4}$ in., and weighed over 4 ozs. It was caseo-necrotic throughout.

Left Prescapular Gland.—Contained a small tubercle.

Right Prepectoral Gland.—The spherical prepectoral gland, an $\frac{1}{8}$ in. in diameter, was similar in structure to the right prescapular.

Axillary Glands.—Normal

*Thorax.**Pleura.*—Normal.

Lungs.—The anterior lobes on the left side were completely consolidated, those on the right were partly so. They were studded with prominent grey nodules of various sizes, some irregular evidently compound nodules being as much as a quarter of an inch in long diameter. The rest of the lung was studded with similar tubercles, each surrounded by a zone of dark reddish-grey colour, irregular in outline.

On section the lung was found to be composed of dark reddish-grey consolidated lobules, with rectilinear outlines, about $\frac{1}{2}$ in. to 3 in. in diameter, though sometimes larger areas were produced by confluence of smaller ones. In the left lung about half the tissue was composed of these solid lobules, in the right considerably less. The solid portions had a grey deposit of tuberculous tissue arranged in a moss-like pattern. Both in the consolidated and the air-containing portions tubercles like those seen on the surface were somewhat sparsely scattered.

Trachea.—Normal.

Thoracic Glands.—Were much enlarged, and together weighed 9 ozs. The long thoracic gland weighed 4 ozs., and measured 5 in. by $1\frac{1}{2}$ in. by $1\frac{3}{4}$ in. The others were enlarged in the same proportion. There was much oedema round the glands. They were composed of caseous striae and networks in a grey translucent matrix.

Heart.—Normal.*Abdomen.**Peritoneum, Omentum.*—Normal.

Intestines.—A few small tubercles were seen in the small intestine; the large intestine was normal.

Mesenteric Glands.—Contained a small number of rather large tuberculous nodules up to the size of small peas, grey and translucent, with ramifying caseous centres.

Spleen.—Contained a moderate number of tubercles, about fifty being seen in a longitudinal section. Some of these were rather large, being about a $\frac{1}{8}$ in. in diameter.

Liver.—On the surface of the liver was a small number of tubercles, a few being an eighth of an inch in diameter. One on the under surface attained the

size of a quarter of an inch. Small tubercles were sparsely scattered throughout the liver substance.

Hepatic Glands.—Were enlarged, and similar to the thoracic, though not quite so advanced.

Kidneys.—A small number of tubercles (about twelve) were found in each kidney, fibrous, with opaque centres. The fat had disappeared from the pelves, which were very oedematous.

Suprarenals.—Normal.

Renal Glands, Lumbar Glands.—Were much enlarged and severely affected, their cortices being entirely composed of confluent nodules like those described in the mesenteric glands.

Iliac Glands.—Left contained a small tubercle. Right normal.

Ischiatic Glands.—Normal.*Genito-Urinary System.**Testes.*—Normal.*Special Glands.*

Precrural.—Left, contained large caseating nodules. Right, normal.

Pubic.—One contained a nodule.

Popliteal.—Normal.

Submaxillary.—Normal.

Parotideal.—The right contained a single tubercle. Left, normal.

Pharyngeal.—Contained several rather large tubercles.

Hyoid.—Contained large tuberculous nodules.

Tongue.—At the base of the tongue the circumvallate papillae were enlarged and warty in appearance. They seemed to be slightly ulcerated.

Tonsils, Pharynx, Larynx.—Normal.

Microscopical Examination.

Tubercle from Small Intestine.—Tubercle bacilli very numerous.

Warty Excrescence on Tongue.—No tubercle bacilli.

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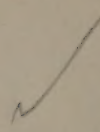
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